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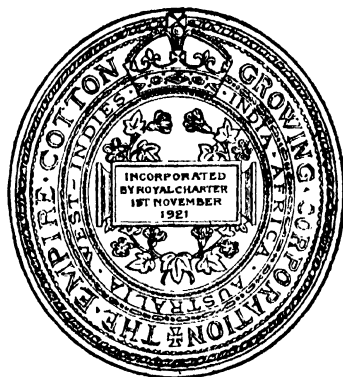
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NO. 1

COTTON IN TANGANYIKA TERRITORY

BY

E. HARRISON, C.M.G.,

Director of Agriculture, Tanganyika Territory.

IN the issue of this Review of July, 1930, an article was included upon cotton growing in Tanganyika, written by my predecessor, the late Mr. A. H. Kirby, O.B.E. In it he discussed the history of the crop in the territory. Since 1930 the market price for lint has fallen heavily, and for the past five years the f.o.b. value per bale has been about two-thirds of what it was during the previous five-year period. When it is recollected that almost the whole of the fall in price is borne by the producer, it will readily be realized that the grower of seed-cotton is, on the average, receiving prices which are about one-half of those to which he was accustomed in earlier years.

The immediate result of this heavy fall in price was a reduction in the acreage planted, and in the season 1931-32 the production of cotton lint fell to the level recorded in the season 1923-24; in other words, the industry went back in production almost to what it was soon after the war. The effect of this fall, which had been noted as a steady decline since the season 1929-30, was to cause many ginnery owners to neglect and close their ginneries, particularly as competition for the small crop was severe, and the quantity of seed-cotton which could be purchased was insufficient to justify the running of a ginnery. Thus, despite competition, despite a superabundance of ginning facilities, the production of cotton fell at an alarming rate.

REORGANIZATION OF THE INDUSTRY.

It became clear that neither the buyer nor the ginner could resuscitate the growing of the crop, especially as whatever some of them might do to encourage it there was no certainty that others, who had

done nothing, would not eventually buy the crop. The person who did not use his resources to help create the crop was naturally in a better position to buy it when it was finally marketed.

Reference to the annual reports of this department for the years 1932 and 1933 will reveal the steps which were taken to localize and support the influence of ginneries, and to give their proprietors some interest in the condition and quantity of the crop grown within a reasonable distance of any ginners. The method of approach was simple enough. Where a ginners served an area distinct and to all intents separate from adjoining areas, a zone was created, all cotton grown in it to be ginned by the ginners serving that zone. A fair maximum charge for ginning was imposed, so that the producer and the buyer could not be exploited. It was hoped that by this means disease carried by seed would be localized. Further, because of the fact that a zone provides its own seed from the previous year's crop, without admixture from other areas, there would be more likelihood of uniformity in the lint.

Where, however, zoning was difficult on account of the siting of the ginneries, as in the Eastern Province, in the case of Kilosa, and the central part of Morogoro, the position was met by closing the district so that Kilosa-grown seed-cotton had to be ginned in the Kilosa district; similarly with Dar es Salaam, Rufiji and the Southern Province. On account of the nature of the Lake Province and the siting of the ginneries there, it was not considered feasible to zone ginneries or to close districts, but by the method of exchange of seed-cotton ginneries arranged to handle the crop bought in the region of their ginneries.

A minimum or fair price to be paid for native-grown seed-cotton was contrived, based on futures and anticipated premiums, which allowed for the cost of buying, ginning, baling and realizing lint. The price is changed with the fluctuations of the Liverpool futures market, and promulgated twice weekly. The object of this is to prevent the exploitation of the grower in areas where there is no competition for seed-cotton, and it is especially important in those zones in which at present, owing to the smallness of the crop, the ginner is the only buyer. It obviously cannot be a full price, and there is a strong tendency on the part of buyers to pay no more than the price promulgated.

It was anticipated that these provisions would at least give a ginner something to work for, and that control of minimum prices would operate in such a way as to assure the grower of a moderately fair deal. It was not contemplated that this system would function without alteration; increase in the crop should in time permit of

the introduction of additional facilities. Furthermore, there is an increasing tendency for natives to bulk their seed-cotton and deliver direct to the ginner, in which case the commissions paid to buyers at buying posts are saved. This is an important concession, as on the prevailing low prices the buying commission works out at about 10 per cent. of the value of the crop to the grower.

Propaganda on the part of officers of the Government, reinforced by the work of some of the ginners and cotton buyers, was undertaken to popularize what experience had shown to be a highly suitable cash crop of great value in a rotation of cropping. The results have not exceeded expectations, but they are somewhat encouraging.

The attached graph, which shows the production of cotton each season as determined by the bale exports May-April each year, together with the f.o.b. value of a bale of cotton each season, will more clearly indicate the fall in value which has prevailed and the increase in outturn of the crop since the "Increase Planting" campaign started in 1931-32. As this paper is to be published before the results of this (1935-36) season's outturn are known, it is possible to give only an estimate, derived partly from known results of the quantity grown and the value per bale which determined the price at which the native sold his cotton in the 1935 season. These estimates are included in the graph.

NON-NATIVE COTTON PRODUCTION.

Cotton growing by non-natives has had a chequered career. High prices in the twenties encouraged the non-native planter to clear large acreages and to speculate with the crop. Some few were capable planters, but a greater number were speculators. Furthermore, the crop was used as a nurse or cover-crop by sisal planters, who found in it a means whereby the cost of establishing sisal could be offset. The non-native cotton planter was unable to face the heavy fall in price, and the yields of cotton per acre have not risen but rather fallen with the economic crisis. Played-out land, incomplete cultivation, rat damage, vagaries of climate, which have been most marked during the past three years, together with a presumed falling off in the yielding capacity of the strain of seed used, have all contributed to a lessening of interest in the crop. On the other hand, the crop has been put under irrigation by one or two non-native planters who are able to produce at a profit, particularly as the supposedly deteriorated seed has yielded one bale of lint and more per irrigated acre, and that on areas of over 100 acres in extent. Furthermore, with the fall in price of labour and the periodic suppression of the rat pest, more cotton planting has been

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done in the Eastern Province and the outturn from non-native plantations has risen.

While much remains to be done before cotton can be said to be a good crop for non-native planters, the fact remains that it can be a good and profitable crop on a sixpenny middling market. Unfortunately the cotton planter rarely plants any other crop, with consequent diminishing returns and increased pest incidence.

Non-native production in 1930 was 5,888 bales; in 1931, 1,835 bales; in 1932, 1,229 bales; in 1933, 3,250 bales; in 1934, 4,540 bales; in 1935, 5,000 bales estimated. One may deduce that the slowing up of planting of new sisal areas which has occurred in recent years has affected the output of cotton by non-natives almost as much as have the lower prices and all the other factors mentioned above.

A long-range five- to six-year trial on a commercial scale, with 500 acres of cotton planted each year on a 1,000-acre all-cultivated farm, using a Diesel tractor (because "fly" precludes the use of oxen) and disc cultivators, ploughing only once in four years on our lighter Eastern Province lands, would demonstrate the utility of much of the unoccupied fly country as a business proposition in these times, and ought to be initiated.

The business of production and its progress has been put first in this paper, because it represents what cotton people are living on and what this territory has to improve upon. What is being done in the direction of improved output for the future will be shown subsequently.

GINNERIES AND GINNING.

The territory is more than well supplied with ginneries, and little difficulty is met with in regard to the provision of equipment. Unfortunately many of the factories are in a poor state of repair, and require overhaul and alteration. With an inordinate number of ginneries and a small crop, it has been difficult to justify any serious expenditure on those items. However, now that the production is increasing, and with the generous provision of two resident ginnery inspectors by the British Cotton Growing Association, the quality of the work done by ginneries should improve. Almost any mechanic may profess to be a ginnery engineer, and as the cotton industry is largely in the hands of operators with little beyond local experience, the need for close supervision of the operation of ginning is manifest. This inspection should be of great advantage to the industry and to the proprietors of the ginneries. As the requirements of the inspectors are met, it is expected that ginning percentage outturn will improve, that there will

be fewer accidents and, possibly, a reduction in the insurance rate on the factories and their contents.

LOCAL MARKETING.

The marketing of seed-cotton grown by natives followed Uganda methods of the past, and on the whole it has succeeded, though not without abuses. Cotton market plots were leased and the owner built a rat-proof store. Unfortunately the markets were not, or could not be, established close to townships because of the danger of rats, and therefore of plague, although presumably the buildings were rat-proof. The result was that, in several instances, markets have been sited at some distance from the centre of cotton production, where it is costly to run them. This is especially the case in the Morogoro district. Furthermore, while the owner of a cotton store could buy cotton only at the market at which his store was situated, he could also send out lorries everywhere to collect cultivators and their cotton, and bring them to his store where the cotton was bought. These lorries carried more human weight than produce, and such transport was dangerous to life and limb. Anything more wasteful, or anything more indicative of the margins on which seed-cotton was bought could not have been devised. Not only that, but the number of people attempting to buy seed-cotton was so great that it was unlikely that a buyer could operate at all profitably, recollecting the size of the crop, the plot rental he had to pay, the license fee and his general expenses.

It was clear enough that what the people needed was some place at which they could sell their seed-cotton not too far away from cotton fields, thus saving portorage, lorry transport and so forth. In many places in this country the limit of production of a commodity is measured by the amount of it which can be carried to market by the producer, hence more widespread buying facilities were desirable if production was to be increased. Steps were taken therefore to establish pioneer buying posts, subject to the fair-price scale, and opening once weekly or once a fortnight. Competition was certainly eliminated, and supervision was constant. As production increases it will be possible to introduce the element of competition and to declare market days for these places.

The motor lorry—inexpensive when properly used, with its flexibility, and with the construction of district roads—has altered the whole complexion of the marketing problem in this territory. It has already rendered some ginneries redundant, and has made it

unnecessary for large stores to be erected at markets to accommodate the produce bought there. The rapidity with which market stalls are cleared of produce is remarkable, and it is now possible to establish markets cheaply wherever they are needed, in the knowledge that the produce bought there in any one day can be transferred to a store close to rail or ginnery within a few hours.

IMPROVEMENT IN YIELD AND QUALITY.

Although investigators have been working on cotton selection in this territory for many years, no type of cotton has yet been isolated locally which has proved better than the bulk from which it was selected. Failure may in part be attributed to an endeavour to select strains which are super-excellent, especially in lint length. Tanganyika is a country for rain-grown cotton, and by good fortune it grows an excellent quality naturally, especially in the Eastern Province. The department has constantly been advised to attend to lint length. It is so far unfortunately true, here at any rate, that an increase in lint length is accompanied by a decline in other virtues in the plant, chiefly yield and robustness.

Furthermore, in a rain-cotton country such as the Eastern Province the varied seasons experienced do not encourage a practical man to use a "pure line" with its more rigid climatic and cultural requirements.

With the experience of the introduction of selections from neighbouring territories, both to the north and to the south, we still feel that in the improvement of the existing bulk cotton lies our salvation. Selections from Barberton of U/4 derivation do excellently the first year, thereafter showing a tendency to fall to the level of our general crop. Selections from Uganda, and pedigree varieties from America and Iraq, have not on test stood up to the conditions, and selections from Nyasaland are under trial, but we are not sanguine that they will help. However, while the main work for crop improvement will be with our existing cotton, the above experience will not deter the department from trying any strain from elsewhere which appears to have a ghost of a chance.

Our chief hope, then, lies in mass selection from our present cotton fields. The type must be robust, of even lint length; capable of survival through a drought of six weeks or more; capable of resuscitation even when the plant appears to be finished; capable of surviving cold weather and, on the advent of the warm months, of flowering again and producing a second crop; and, by its constitution, able to

frustrate the attentions of some of the many pests which attack it. It will be seen that the demands of the country to the east of the Rift Valley are not simple to meet. Furthermore, whilst a native can grow cotton in rotation with other crops, the planter does not, and it is desirable that he cease to call exclusively for *better seed* and attend to the betterment of his soil and his farming system. We know that the country strain can yield, under rain, 400 kilograms of seed-cotton per acre on land in good heart, so that deterioration of seed is not perhaps a reason, and certainly not the exclusive reason, for poor yields over large areas in Kilosa and Morogoro.

Much has been made of the premium. This has fallen from 2½d. per lb. to 1d. per lb., and seems unlikely to go higher. In fact, we are very little better off striving for super-excellent cotton. In U/4 bulk we have a cotton the lint from which is good, and it appears to be very much like our ordinary country bulk cotton. It has this virtue, however—and here, I think, we regain the money lost in the premium—that its ginning percentage (using a new well-set gin) is as high as 34.5 per cent., a clear advance over the usual 31 per cent. of Eastern Province bulk. One-tenth more lint from the same weight of seed-cotton surely makes up for any likely loss of premium, recollecting that yields of seed-cotton per acre of U/4 bulk and our country bulk are identical or nearly so.

There is a matter of grades of seed-cotton, particularly important in areas such as Kilosa and Morogoro, where both native and non-native planters grow the crop. When the native was a small producer, growing half an acre or so, it was reasonable to require him to grade his pickings very carefully into "Native No. 1," "Native No. 2," and "Native No. 3," which means very clean, clean, and dirty seed-cotton. The non-native planter picks two kinds of seed cotton, equivalent to Native No. 2 and No. 3, called "Crop No. 1" and "Crop No. 2." From Crop No. 1, did he choose, the planter could pick out the stained and dirty portions and produce a passable Native No. 1; but generally he has neither the labour nor the inclination to do this. Natives who are growing large acreages per family are equally disinclined to sort over their Native No. 2 pickings, and it is futile to require them to do it. Were this insisted on, it would act as a distinct check to the expansion of native-grown cotton.

As we are satisfied that there is practically no difference in the ensuing crop by using seed from the first pickings of Native No. 1 and by using seed from the first pickings of No. 1 (non-native) crop, on the score of seed supplies alone we are not justified in pressing for the production of such a high grade of No. 1 native cotton. Furthermore,

it is well known by all cotton growers that non-native planters are paid as much and generally more for their No. 1 crop as natives for Native No. 1, which is really of higher value; and it is not understood why a less valuable type of seed-cotton should be paid for commonly at greater rates than is Native No. 1. The fact that natives often sell retail through the agency of middlemen does not account for the whole of the difference. These differences do not operate in the direction of contentment, and since a native is so concerned and anxious to get the ultimate cent for his produce, it is wise to meet him as far as circumstances permit; otherwise he is easily put off the production of what is an inedible crop—its only appeal is that of the cash value.

The solution lies in many hands: the native is inclined to join with his fellows, pool the crop and realize it in bulk; in fact, he may go so far as to have it ginned and realize the lint. The working of the price scale reveals that, although natives are receiving no higher prices than formerly for the No. 1 grade, they are actually getting better prices for their No. 2 and No. 3 grades over those paid a few years ago.

It may be sounder to promulgate a full price for Native No. 2 equal to No. 1 crop, and for No. 3, and inform the seller that, if his seed-cotton, on inspection at the market, is classed as Native No. 1, then he is entitled to a premium which may also be declared, the premium naturally varying with the market. However, in some places natives combine in bulking, deliver their seed-cotton to the ginnery, and make the best possible bargain they can with the ginner, thus eliminating buying commission and economizing in transport. There are signs of this arising in many places.

Outside the Lake Province, the main trouble with cotton in this territory, commercially, is that there is insufficient output. If this increases, there should be more competition, ginning rates should fall, and the return to the grower should rise. In my opinion the department has too long given heed to counsels of perfection; we want cotton and we want the crop to be grown more freely and to become a popular crop to grow. Furthermore, the department's business is to see that the present temporary aids to development should gradually give way to a more rational and less "rationalized" handling of the crop as soon as output warrants it.

COTTON STATIONS.

The department is fortunate in having the support of the Empire Cotton Growing Corporation in connection with cotton experiment stations. There are six of these, but two are only offshoots of two of the others.

EASTERN PROVINCE.—The stations are Morogoro and Morogoro Extension (Kingolwira), and Mpanganya (Rufiji). Cotton selection work is done from Morogoro; planting out of selections may take place either at Morogoro or Kingolwira. The extension at Kingolwira is a very large block of land on which multiplication of strains is carried out. A small quantity of improved seed if issued to planters or natives in a large district passes through many vicissitudes, and it is our opinion that not until we have a quantity of several tons grown under our own observation should there be an issue outside for further multiplication.

On Kingolwira we are hoping to establish native farmers who will assist in the multiplication of strains, as there we have a large area under observation and control.

At Morogoro we have had many strains under trial, mainly imported, but so far have found none which give promise of superseding the district bulk. Selections show up well for a period and then fall back, but promising and interesting selections from district cotton are made each year in the hope that several will be isolated which represent an advance; mass selection is carried out. U/4 (bulk) and "998" both show up well at Kingolwira; and there is sufficient seed of these for us to go ahead with comparative trials over large acreages in the district.

Mpanganya.—This old cotton station has been reopened for the regeneration of cotton types useful on the alluvial lands of the Rufiji and Kilombero valleys. These lands are known to produce good quality cotton naturally, and there may be an opportunity of developing a type for these areas which is better than the usual Eastern Province cotton. Here, it is believed, increased lint length may be obtained.

LAKE PROVINCE: Lubaga (Shinyanga).—This large station is maintained for the production of types suited to the semi-arid hinterland of the Lake Province. U/4 derivatives have done well in the past, but experience shows that they are not altogether suited to the conditions, and that selection in the area and from U/4 bulk is likely to be the right way in which to provide the cultivator with a paying cotton. Here also natives are instructed in the ways of a more advanced system of agriculture, in order that they may leave the circumscribed sphere represented by a hoe. The Lubaga station is well equipped for its functions.

Ukiriguru and Ukiriguru Extension (Nyamahona).—Ukiriguru is a station which deals with the cotton grown in the Lake Shore area. This cotton closely resembles that grown in the Morogoro district. Here, however, it is possible that a pure line may be isolated showing

an advance on the district bulk. Mass selection from that bulk is under multiplication, a significant increase in yield having been shown by the selections made and used as a bulk.

Ukiriguru Extension, where multiplication can be undertaken, has been opened in country to the west of Smith Sound, country into which surplus population from the densely occupied areas of the Lake Province is drifting. It is hoped that a number of these people will pass a period in employment and training on the extension, and that settlement will proceed from the farm as a centre. Unfortunately the people who are leaving the Lake Province area—and who *should* leave owing to pressure of population—are too numerous to be dealt with in any organized way, but an opportunity presents itself for so dealing with some of them in a new settlement. Finance to develop water supplies in this area is needed.

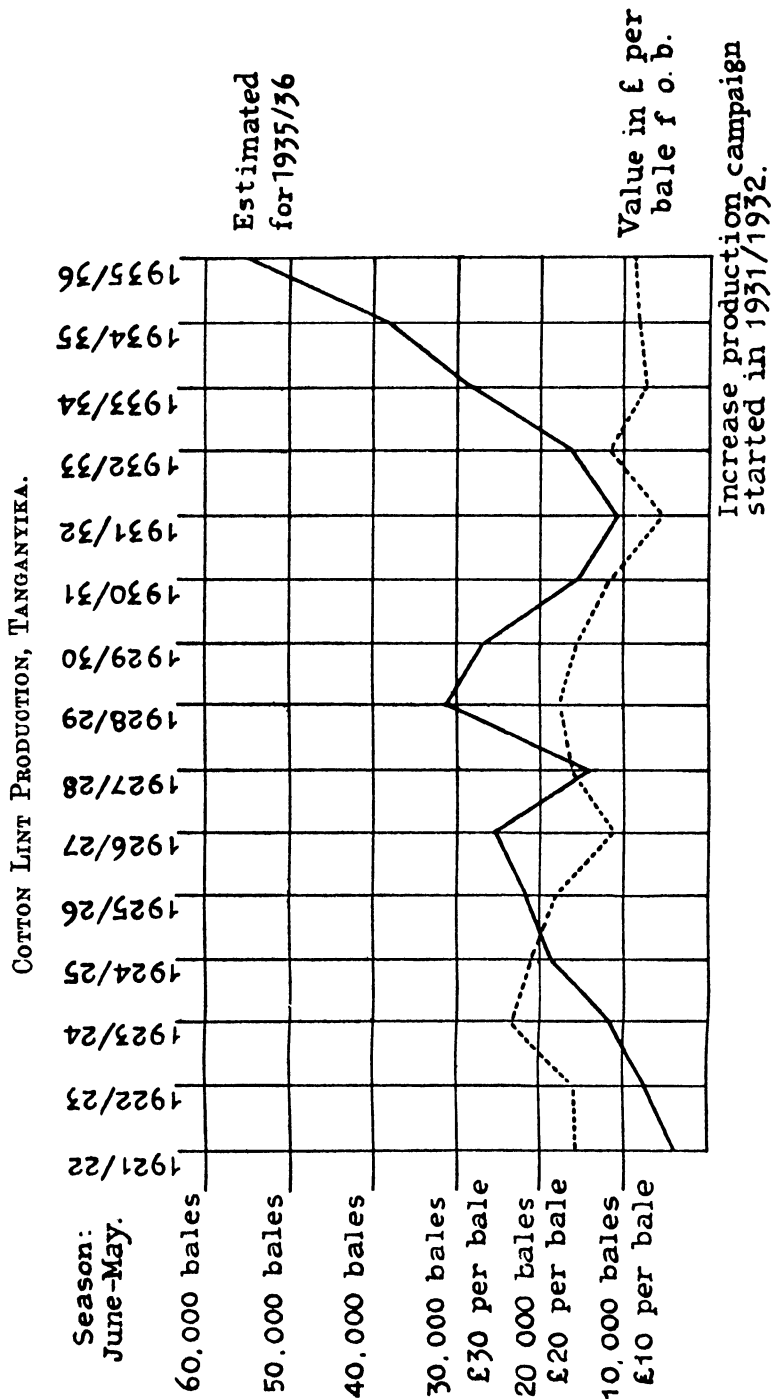
The possibility of the establishment of a more scientifically controlled and directed central cotton experiment station comes to mind from time to time as we find that neither from the north nor from the south do we secure the strains we should like to have; but its establishment must await further enquiry and experience.

The cotton pest position is carefully watched; almost the whole time of a trained entomologist with a native staff is spent on the study of insects prejudicial to the crop. Many of these pests are a menace on account of bad cultural operations and lack of field sanitation; a few, however, require study from the plant-breeding angle.

The work for cotton improvement which the department is doing on these stations must in due course reflect itself in the yields of the cotton fields of the territory.

I have not mentioned particularly the Tanga and Northern provinces, where by irrigation large yields of cotton are possible, nor the possibilities of the Southern and Iringa provinces. There is no reason why cotton production in the territory should not continue to increase; we are now passing the 50,000 bale mark, and it is not too much to expect that within a very few years the 100,000 bale mark will be easily in sight. The crop fits well into native cultural rotations and should gain in popularity.

Received November, 1935.



Graph shewing production for seasons. - June-May; and average f.o.b. value per bale of 400 lb.

COTTON IN NORTHERN NIGERIA

BY

G. BROWNE,

Manager of the Seed Farm, Daudawa.

I.—THE WORK OF THE CORPORATION'S SEED FARM.

TEN years ago, at the request of the Government of Nigeria, the Corporation started a seed farm at Daudawa, in Northern Nigeria, which has been gradually extended until it has now reached an area of 900 acres. The principal function of the farm has been the multiplication of strains of cotton selected and supplied by the Department of Agriculture, and the testing of these under large-scale conditions in order to find out whether such strains are suitable for distribution to native farmers. In this way large quantities of seed have been produced annually, but in some years the strain that has been multiplied, when tested on this scale, has proved to have some defect, such as an insufficiently high yield or insufficient resistance to some pest or disease. The seed from such strains has consequently had to be discarded, but even such negative results have had their value, as, without the large-scale test, the strain might have been put into general cultivation and caused loss and disappointment to native growers.

Besides this work, much knowledge has been gained of other crops, thus enabling advice to be given to the natives on intercropping some of these crops with cotton: this practice, which allows two crops to be grown on the same land in one season, has been increasingly adopted, but the evidence obtained goes to show that better results are secured if the two crops follow each other as closely as possible, instead of being grown almost simultaneously. This information also has its value for the native cultivator.

Intensive cropping of this kind naturally makes it essential that the fertility of the land should be maintained, and it became clear that this was not being secured by the method of green manuring employed in the early stages. Accordingly, in 1929 the experiment of keeping a few cattle was tried, in spite of the risk of loss from trypanosomiasis; and in a note recently prepared by the writer, and included as Part II. of this paper, a brief account is given of the introduction of cattle cultivation at Daudawa.

A co-operative farming scheme was started in 1927, and twenty-six farmers have been settled on the land, who now produce about a bale of cotton (lint) each. This season, at the suggestion of the Agricultural Department, a scheme has been started for settling tenant farmers on the land who will practise mixed farming—*i.e.*, using cattle for cultivation and systematic manuring. The scheme—which is already making rapid progress in other parts of Northern Nigeria under the stimulus of the Agricultural Department—consists in setting up farmers on land already cleared, and providing them with two cattle and a plough, to be paid for in instalments. Its main object is to enable the size of individual holdings to be increased from about 3 acres—which is about all that a man and his family can manage when cultivated by hand—to 10 acres, which are within his reach when cattle are used. Moreover, the farmer who has gained experience in this way will not remain satisfied with 10 acres; he will increase his area and buy some more cattle and another plough: this has, in fact, happened already.

The Hausa countryman is intelligent and fairly industrious; he is a keen trader and knows quite well on which side his bread is buttered. It may also be added that he has taken to cattle in a most surprising way, although he has never had anything to do with them before.

It is believed that the introduction of mixed farming will do more for the increase of cotton production in Northern Nigeria than any other step that the Agricultural Department have so far taken, and the Corporation have gladly associated themselves with the scheme. Naturally no increase in output can be looked for immediately, as the system must first become widely established and the farmers learn how to make the best use of their cattle; and this cannot come all at once. In the past the Hausa has never owned cattle; it is easy to imagine, therefore, what it implies when he is asked to leap forward a few hundred agricultural years at once from the practice of the primitive methods of shifting cultivation and the use of a grass fallow to an era of ploughs, cattle cultivation, manuring, cow keeping and milk production. How long would it take to induce English farmers to make so drastic a change in their methods? Yet the Hausa is taking to the new practice in large numbers already, and it is estimated that by the end of six years, provided sufficient suitable cattle are available, there will be 10,000 mixed farmers in Northern Nigeria. What the corresponding increase in cotton production is likely to be is difficult to estimate, but if each farmer only produces one bale of cotton more than he did before—and this estimate is

based on very conservative figures—it means that within six years Northern Nigeria should produce an additional 10,000 bales a year as a direct result of the introduction of mixed farming alone. Moreover, there is probably no cotton-growing country in the world where the crop can be produced more cheaply. Furthermore, the population is increasing owing to increased birth-rate, improved health, and the cessation of raiding. Arising out of the last cause, the community is breaking up into smaller units the groups in which they have formerly lived for security; farmers' sons also are striking out more on their own account, and within a comparatively few years the number of individual farms may be increased to anything between four times and fifteen times their present number. It may therefore be stated with confidence that a large expansion in general agriculture may be looked for in the Northern Provinces of Nigeria, that of the several factors to which this expansion will be due, cattle cultivation will be probably the most important, and that a notable increase in the output of cotton will be one of the outstanding results.

The immediate problem confronting the Empire Cotton Growing Corporation is how their farm at Daudawa can help towards bringing about this expansion. A Home Farm is being retained, which it is hoped will serve as an example to the tenant farmer on the surrounding estate, who will also be given all possible advice and assistance. Daudawa has already had a marked effect on the methods and standard of farming over a wide area. Some of the surrounding farmers have worked there for a time and then returned to their own farms and put in practice what they have learned; many others have paid visits to the farm—often coming from considerable distances—because of reports that had reached them of the new farming. In each case the result has been the same—namely, improvement of native farming methods on the initiative of the natives themselves.

One important rôle that the Corporation's farm can play is, then, to serve as an example, first to the Mixed Farming Settlement Scheme on its own land, and then to the whole surrounding district. If it does this as adequately and effectively as is hoped, it should prove the best possible means of propaganda for the work of the Agricultural Department in the push that it is making for a great expansion of agriculture in Northern Nigeria.

II.—CATTLE CULTIVATION AND ANIMAL HUSBANDRY AT DAUDAWA, NORTHERN NIGERIA.

In this note an attempt is made to give a brief account of the introduction of cattle cultivation at the Corporation's seed farm at Daudawa. Reference is made to our early difficulties, the mistakes that have been made, and the means whereby we hope to have overcome some of the principal obstacles. The many advantages to be gained by cattle cultivation are also touched upon. It is hoped that our experience may be of interest to members of the Corporation's staff, though it is, of course, recognized that it may not be directly applicable where conditions are widely different from those at Daudawa.

In the early days of the Daudawa Seed Farm—*i.e.*, nine years ago—it was thought probable that if a farm of the size then intended (about two square miles) were to be worked satisfactorily mechanical cultivation would have to be employed; in fact, the farm was laid out with that intention in view. About 1927-28, however, experiments in cattle cultivation were being carried out by the Agricultural Department, and it was then decided to try it at Daudawa. A start was made in a small way, but owing to many difficulties, principally trypanosomiasis and the then inefficient wooden implements, the effort more or less died away. Another and more determined start was made in 1929-30, and notwithstanding many formidable obstacles, progress has been rapid, until now practically all of the 900 acres under cultivation at Daudawa are treated in one way or another by cattle-drawn implements two or three times a year.

Five or six years ago the herd consisted of three bullocks, and these were slowly added to in the first two or three years. Today the herd numbers 180 head, about 120 of which are working bullocks and the remainder cows and calves. Attempts are being made to produce better working types of animals by breeding, and now that a sufficiently large herd for our needs has been built up, it is possible to practise greater selection in purchasing, with a view to replacing the poorer-class animals.

The greatest difficulty which had to be met was that of health; reference will be made to this subject later.

By far the greater part of the work done by cattle is ploughing. As soon as the land is soft enough for the plough, preparations are made for the coming season's crops. The D.Y. ridging plough was introduced by the Corporation, and this, though possibly by

no means the ideal implement for more or less general use in Northern Nigeria, has undoubtedly been of great service in the extension of cattle cultivation. Attempts are being made to evolve a still more efficient implement. Other implements of the plough kind and cultivators of different sorts have also been tried. In addition, new and stronger forms of cattle-cart have been designed, and an entirely new and most successful method of yoking a single cart has been devised—all of which are available for the native farmer to copy.

There are twenty-five D.Y. ploughs, and when all these are working one hundred head of cattle are employed, for each pair of animals only works half a day, a fresh pair being employed for the other shift. The morning shift starts at 6 a.m. and works until 10 a.m., while the afternoon shift commences at 3 p.m. and stops at 6.30 p.m. Originally cattle were worked whole-time in the same way as the men who use them, but this was found to be one of the contributory causes to the high mortality-rate from which we suffered in some of the earlier years, so now the animals only work one shift per day, and the results have been very satisfactory. About forty acres per annum are "deep-ploughed" by means of a heavy R.S.L.D.X. double-furrow plough. This implement requires a minimum of six head of our best cattle, though in other countries—such as South Africa, where cattle cultivation has been practised for a considerable time—probably more than twice that number would be used. There seems little doubt that in Nigeria we do not use big enough teams for our work, but it must be remembered that the use of cattle agriculturally is only in its infancy in this country, and that when larger numbers of trained cattle and cattle-men are available, bigger teams will probably be used for all our work, with a consequent improvement in the health of the herds and the extension of their period of working life.

Cattle are sometimes employed in harrowing and in general inter-crop cultivation. There are also other forms of work connected with the farm, principally carting wood, manure, hay, silage, and bedding, etc., all of which are done by means of cattle.

Our experience is that a pair of bullocks (that is, four bullocks on the half-shift system) should plough two to three acres of land per day, and even more, but much depends on the state of soil and whether the plough and team are working efficiently. They are also used extensively at Daudawa for inter-crop cultivation, particularly for cotton; on this work a single bullock drawing a light P.I.K. plough will easily do three acres per day.

The animals are given a good daily ration of grain and cotton seed (the latter being steeped in water until soft), and in the mid-day period, and also after the evening shift is finished, they are grazed in the near-by bush. Hay is also given them; in fact, we find that working animals require all the food they can be given when not working.

Training is usually done by yoking up the animal which requires training together with an "old hand," and driving the two around without a load until the new beast is familiar with the reins and the cattleman's orders. They are then yoked to a log of wood—usually wood to be brought in for sawing up, so that the time is not wasted—until the new animal works properly. After that they are put into a cart, and so on, until, in due course, they find themselves yoked to a plough. We have often found that cattle which work well otherwise take some time before they get used to the plough. We always encourage the cattlemen to "handle" the animals whenever possible, and to familiarize them to contact with human beings, for this work is absolutely new to the breeds of cattle found in Nigeria.

As mentioned above, very adverse health conditions were encountered at first, but it is hoped that they have now been practically overcome. The principal risk is trypanosomiasis, or the infection caused by the tsetse fly. As is well known, there is no method of really eradicating the infection, but the commonest and cheapest means of dealing with it when it appears in an animal is by the injection of tartar emetic into the main blood stream. This has a tonic effect, and unless the beast is too far gone it assists it in throwing off the attack; but the trypanosomes remain latent in the blood, and if the animal's resistance is again lowered through hard work, or any one of the many causes which arise from time to time, the characteristic symptoms once more appear. Naturally, it is best to remove the cause of the infection as far as possible, and with that object in view all bush adjacent to any stream or pool has been cleared at Daudawa for a considerable distance around the farm and grazing areas, allowing a considerable margin of safety. Some years must elapse before anything in the nature of a "tsetse-free" herd can be claimed, owing to the fact that the trypanosomes are not transmitted from mother to progeny at birth; it is therefore only the calves which can be considered as completely free at the moment, but the removal of sources of direct infection must have a highly beneficial effect, and it is hoped that with time and care the death-rate from this disease will rapidly decrease.

The cattle are inoculated also against diseases such as rinderpest, pleuro-pneumonia, etc., and beyond an occasional small outbreak of the former, little real trouble has been experienced from diseases other than trypanosomiasis. There have been two outbreaks of foot-and-mouth disease, but this is nothing like so serious as it is at home.

A dip has been built, and the cattle are put through once a week during the wet season. This also has been found to have a very beneficial effect on the herd's health. Crush-pens have been erected in conjunction with the yards beside the dip, and these are used for easy treatment of cattle whenever possible, instead of casting, which sometimes harms the animals, especially cows in calf.

The method of housing the cattle naturally has an important bearing on their health, the chief essential being to ensure that during the wet season an animal's back and abdomen are kept dry. Small round mud houses have been found to suffice for two or three oxen, while we are constructing large open pens, half-roofed over and protected on the weather side, for larger numbers. For temporary use, however, long, narrow sheds with open sides constructed of brush-wood and roofed with grass have been found useful. In this type of shed the earthen floor is dug out for perhaps 18 inches or 2 feet, thus providing space for the making of additional manure. In connection with manure production, it may be said here that at Daudawa for the past two or three years the bedding in the cattle-pens has been watered daily during the dry season. This practice has almost doubled the amount of manure produced per beast-year. Finally, the animals are given all the bedding they will take so long as the previous lot has been well trodden into manure.

Fodder racks are erected wherever possible in the houses, and large wooden troughs are placed in the compound for the serving of concentrates and salt, etc.

One of the most important advantages obtained from the keeping of cattle has been the resultant manure. Until cattle were kept at Daudawa, green manuring was practised on the farm. It was found that this did not maintain fertility, and the land was "going back." When only a few cattle were kept and manure production was low, dressings of one ton per acre were given, and even with this extremely low rate distinct improvement was noted. With larger quantities available, dressings of two tons to the acre are now given, and the farm is in better heart than ever before. Apart from the methods mentioned above for the increase of manure production, a modified form of composting has been tried with success during

the dry season. This consists of sinking a pit 20 feet square and 3 feet deep, and placing in the bottom a layer 2 feet thick of waste products, such as groundnut haulms and chaff from the thrashing of cereals, etc. On the top of this is placed a layer about 9 inches thick of farmyard manure, followed by another layer of waste products, and so on. The whole is watered thoroughly about twice a week. So far as our experience goes, it has not been found necessary to turn the midden, and the compost formed has been excellent, but as a general rule turning two or three times would undoubtedly improve it.

Summing up our experience, the use of cattle has been a great success on the whole at Daudawa, and looking back, though I was at one time a great supporter of mechanical cultivation, I am very glad indeed that cattle cultivation was adopted instead. One outstanding fact is that no amount of feeding or persuasion will make the mechanical method produce farmyard manure, and it is certainly the use of manure that has pulled Daudawa back from its downward trend towards minimum production through infertility, and put it on the high level of fertility which it enjoys today. Given normal climatic conditions, the farm will produce as good and sometimes better yields of crops than it did in its earlier years; and in the future, with more manure available, the land ought to continue to improve still further. The adoption of cattle cultivation has thus had a good effect from the point of view both of cotton and of other crops generally; it has also lowered the annual working cost per acre.

The introduction of cattle cultivation into native farming practice also provides a means by which the farmer can readily extend his acreage under crops, including, of course, cotton, in this country.

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SOIL EROSION IN TROPICAL AFRICA AND PROBLEMS CONNECTED WITH IT

BY

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THE losses caused by soil erosion in depleting the fertility of the land is a subject which in many parts of the world has attracted much attention during recent years, but probably nowhere has erosion been such a constant menace to agricultural development as it has been in tropical Africa.

Botanic research has shown that many of the annual crops common throughout the tropics of the Old World are of African origin, such as the majority of the sorghums, the grain pennisetums, the cow-pea, sesame and, probably, the pigeon-pea and the finger-millet. Other cultivated crops are peculiar to tropical Africa, such as the Bambara groundnut and the West African species of cultivated yams and of cultivated rice. It is thus evident that tropical African agriculture must date back for thousands of years. In spite of this, the people of this region have never developed a permanent agriculture, but have always depended on shifting cultivation. There can be little doubt that this state of affairs has been due largely to soil erosion, mostly sheet erosion, which rapidly reduces the fertility of the land, when this is depleted of its natural vegetation either by cultivation or by grazing with stock.

The soils of tropical Africa are much more liable to disintegrate than are those in other parts of the tropics. There is a preponderance of sand present in most of them, and one seldom sees a soil which is sufficiently heavy to crack when it is dry. The only places where these are met with are where the finer particles, washed out of the soil by sheet-flow, have collected in low-lying areas or where these have been deposited as alluvium. Otherwise, the surface soils compared with those of other parts of the tropics are extraordinarily light and very likely to be affected by sheet-flow as well as by gully erosion. In nature the surface soil is protected by ground vegetation, but as soon as this is disturbed, either by cultivation or by too close grazing, rain causes the soils to disintegrate and erosion immediately commences.

The peoples of tropical Africa are primarily agriculturists. They can be divided into two main categories—namely, the pastoral people, who own cattle, and the agricultural people, who do not. The pastoral tribes seldom take any direct interest in the cultivation of the land, but live on their flocks and herds and on such wild plants as nature provides. They are, from their mode of living, a more aggressive and warlike people; for they not only have to defend their stock from wild animals, but, being nomadic, they have to assert their ownership to grazing areas, waterholes, etc. As their herds have increased, they have extended their boundaries in search of new grazing areas, and have thus frequently replaced agricultural tribes. Sometimes this has been their undoing, as they have run into tsetse-fly areas and, having lost their cattle, have been forced to become indifferent cultivators. Until the coming of the white man, the only restriction to their expansion has been the presence of tsetse fly and the existence of high forest or other types of vegetation where grazing facilities do not exist. Thus the agricultural tribes are, as a rule, located in areas where natural grazing conditions are unattractive, and much of the area occupied by them is, or has been, fly country. Such areas include also riverside alluviums, areas where the tree vegetation is too dense for pasture grasses to thrive, areas where high coarse grass, unsuitable for grazing, dominates the ground vegetation, and areas where the rainfall is too heavy for stock to thrive. It is extremely seldom that one finds a combination of stock-raising and tillage. There are a few examples, such as the case reported by Staples, where on one of the densely populated islands in Lake Victoria the people keep cattle for supplying manure to their cultivation. Around Karonga, at the north of Lake Nyasa, the cultivating tribes keep cattle, and at Taveta at the foot of Kilimanjaro, also, a few cattle are owned. These are always kept tied in darkened huts, as it is a fly area. In West Africa from the Gambia to Nigeria the cultivating tribes, dwelling in fly areas, keep a few cattle; these belong to humpless breeds and are said to be immune to trypanosomiasis. It is only when one gets out of the tropics in South Africa that one comes across any real traces of a combination of stock-raising and arable farming among the native tribes. Many of the agricultural tribes in tropical Africa do, however, keep small livestock—mostly goats and occasionally sheep.

Both these types of farming are responsible for erosion. In times past the numbers of cattle maintained by pastoral tribes were kept down by inter-tribal wars, stock raiding, and by disease, but European Administrations have done much to destroy these agencies

for restricting grazing. As far as East Africa is concerned, overstocking and consequent soil erosion have become perhaps the most serious problem of administration, and unless overstocking is checked, erosion seems likely to destroy these people whose existence is solely dependent on their livestock. In many places the grass cover of the land has now been entirely destroyed and there exists only scattered, useless ground vegetation. In the dry season the surface of the ground is completely broken up by the feet of the animals seeking for something to eat, so that when concentrated rain falls, as it does in these dry grazing areas, the water, unable rapidly to penetrate the dry ground, rushes off the surface, often carrying with it the whole surface soil. In places, conditions have become so bad that there is no possibility of the natural regeneration of the grass flora, as no grass is left to form seed for reseeding the area. The only plants which survive are those which stock avoid, such as thorny acacias, ground succulents, *Cassia* species, etc., and these are rapidly dominating the flora of such regions, which are fast becoming deserts.

Evidence exists to show how rapid this deterioration is. Chapter X., Part III., of the Kenya Land Commission Report is devoted to this subject of overstocking, and gives numerous examples of large areas where desert conditions have succeeded what even twenty years ago were rich grazing areas. It is pointed out also that, though the numbers of cattle owned by these pastoral tribes have doubled within the last twelve years, yet such is the miserable condition of these animals that the products of this industry have actually decreased. It might be suggested that the solution of this trouble could be found in turning the attention of the people to the cultivation of the land, but as conditions now are, any such attempts would be wasted, because, when rain falls, so rapid is the run-off that water has not time to penetrate into the ground.

Much has been written about the evils of shifting cultivation in depleting the fertility of the land, but the effects of this are as nothing compared with the havoc which can be wrought by overstocking.

The agricultural tribes can scarcely be blamed for the established custom of shifting cultivation. Under the present distribution of population, these people are entirely dependent on the existing fertility of their cultivated plots, and without manure there must come a time when the land will cease to yield sufficient produce to warrant cultivation. Their resources for manuring the land are practically non-existent. They do not own livestock sufficient to



Twenty years ago this was a grazing country, but it is now bare of ground vegetation. Cattle are kept alive by feeding on the bark of branches and stems of *Acacia*, which are ruthlessly cut down for this purpose.



The people of this area, who show evident signs of under-nutrition.

produce manure, and the only method they know of manuring the land is to cut and burn the vegetation when they are making a new clearing. Thus a system has been evolved of allowing the land to revert to bush growth, so that it can recuperate, while a new area is cleared and burnt for future cultivation, till that in its turn is temporarily exhausted. Much of the surface soil of Africa being very sandy, when it is depleted of its natural cover the finer particles are very apt to be washed away or washed deeper into the ground, thus leaving the surface soil in a greatly impoverished condition. The natives, although frequently blamed by Europeans for their habit of shifting cultivation, are extremely good judges of land, and close observation will show that they do not abandon a clearing until forced by necessity to do so. Where soil conditions are really favourable one finds conditions which closely approximate to permanent occupation of the land, as, for example, on the red soils of North Kavirondo and of Kikuyu in Kenya, where the density of population is as high as it is on similar types of land in countries where a permanent and highly developed system of agriculture is in existence. It is, however, very noticeable that the land occupied by the two tribes of these areas is strictly confined to a single type of soil. Again, on level river alluviums one finds conditions approaching permanent occupation of the land. Village sites are much more permanent and land is rested for only short periods. It often seems as if the land is abandoned more on account of too heavy a weed growth than from soil exhaustion. Such land seldom reverts to a bush fallow, as on account of continuous cultivation, tree vegetation has ceased to exist, but it grows a succession of useful weeds, which appear to check the growth of the more objectionable species and thus again render the land fit for cultivation.

Bush fallows play an important part in the agriculture of these people. It really amounts to a rotation of cultivation and bush, the latter being allowed to grow so that the fertility of the land can be replenished. Tree and other wild vegetation can draw on the deeper soil levels for their sustenance, at the same time adding humus and plant food to the surface soil and checking further erosion. Although the lands of a village are generally communally owned, it is the tribal custom among many of these people to recognize the rights of individuals, and if an area has once been cleared, the native responsible for the clearing is entitled to regard that area as available for himself for future cultivation.

Even when making a clearing, the cultivator is careful not to destroy tree vegetation. Any trees in the area are either coppiced

or pollarded—the practice varying in different regions—this being done to ensure that the trees are not killed. After weeding the crops, one often notices that the weeds are piled up around such trees, thus assisting them to recover from the removal of their crowns, and otherwise protecting vegetation. This must to some extent check surface wash from the cultivated plot.

Methods of cultivation also are frequently designed to check erosion. Doubtless many of these have now become customary and their origin is lost in the past. The practice of throwing the land up into mounds and of growing the crops on these mounds is common throughout tropical Africa; sometimes this is combined with the inversion of the soil so thrown up, so that any ground vegetation is buried. This helps to hold the mound together during the first season of the clearing, besides adding vegetable matter for the formation of humus. The presence of these mounds checks the flow of surface water and allows it to soak in, instead of running off and carrying with it much of the goodness of the land. In some areas this practice has been improved upon. Instead of mounds, ridges and furrows are made along the contour, and these are broken so that each furrow catches the water that falls on the ridge and thus prevents wash. In Southern Nigeria, where there is a fairly heavy rainfall and an extended rainy season; these ridges and furrows may be quite large and involve a considerable amount of labour. In the drier parts of West Africa this ridge-and-furrow system of cultivation is generally adopted, and the local hoes are specially adapted not only for making ridges but for inverting the soil on to the ridge. These mounds and ridges when once made are more or less permanent as long as the clearing is in cultivation, and thus they become consolidated; all that is required is to make them up again at the sowing season. Experiments carried out in Nigeria go to show that this is a sound practice, for though these old mounds or ridges may not give quite so much produce, the cost of repairing them is very much less than would be the cost of remaking them. These few examples show that the natives fully realize the losses caused by erosion and consequent soil exhaustion, and their methods are well worth studying not only for themselves, but as a guide to those who seek to improve on them.

Such methods of shifting cultivation answer well enough as long as the population can be kept within reasonable limits. In former times the population of these agricultural tribes was kept down by raiding for slaves, and in some parts of Africa vast areas were depopulated, which have never recovered to this day. Disease

also played a considerable part in checking increases in population. Smallpox, for example, still levies a very heavy toll on life if no protection is afforded, and, though the African does not appear to feel the effects of malaria as the European does, there is no doubt that infant mortality is very severe from this cause. Under European administrations slave raiding has been abolished and internal strife has been checked. Health services are doing much to fight disease and to change the present insanitary habits of the people, and the result which is bound to follow is an increased and more healthy population. Already in many parts of tropical Africa the pressure of population on the land is being felt, and the tendency is for the periods of bush fallow to become shorter and shorter. In order to increase the trade and prosperity of the country, the agricultural tribes are being encouraged to grow crops for export; thus larger areas are being cultivated than formerly were necessary when the only consideration was to supply food for local use.

An extensive literature has arisen in recent years, dealing with methods of checking soil erosion, but many of these methods are only applicable where large areas have been cleared. Some involve considerable capital expenditure and therefore have no appeal to the native, whose plot of cultivation is small and who has no title to the land which he is cultivating.

The problems therefore facing the Administrations of these countries are many. Is it possible to introduce a system of land ownership? Is it possible to bring land under permanent cultivation? Is it possible to create a demand for cattle both for work and for manure among the agricultural tribes, so that a valuable market can be found for the surplus stock of the pastoral tribes? Is it possible to convert the pastoral nomad into a settled agriculturist?

The Agricultural Department in Nigeria has been the pioneer in trying to answer some of these questions. In the southern part of that country, where the rainy season is extended and where agricultural soils exist, it has been proved that land can be kept under permanent cultivation and in a high state of production by the practice of introducing green manure crops into the rotation. The work has been summarized in a Bulletin issued by the Department (*3rd Spec. Bull. Agric. Dept. Nigeria*, 1931), and there is no need to deal with the subject in detail here. The problem which now confronts the Department is to modify the methods employed so that they will appeal to the native. At present the additional labour involved in the cultivation of green manure crops renders it difficult to introduce these methods into native agriculture. In

the dry northern parts of Nigeria such a practice is impracticable, as the rainy season is not long enough to grow a food and a green manure crop in the same season. In this region, however, cattle can be maintained, and advantage has been taken of the fact to demonstrate the possibility of small mixed farm holdings. Remarkable results have been achieved. Individual cultivators have been supplied with a nucleus stock of working and breeding cattle and provided with a suitable area of land. The manure from the stock is used to maintain the fertility of the land, and the area cultivated with the aid of the draught cattle is sufficient not only to maintain the smallholder and his family but to enable him to repay the initial cost of the animals supplied to him. Great progress has been made in establishing these holdings, and in this work the Native Administration has heartily co-operated in financing them and in assisting to stock the holdings. Here, as elsewhere in Africa, the cattle of the country are owned by pastoral tribes, who, in the first instance, showed the usual disinclination to part with their animals; now, however, they are finding a ready market at remunerative prices for their surplus stock. The striking feature about this work is that the interests of the individual are the primary consideration. In other parts of Africa the introduction of ploughs and the utilization of cattle for ploughing have been an important part of the work of Agricultural Departments, but there is nothing to show that any attempt has been made to utilize their introduction to improve the individual status of the people and to render the land cultivated permanently suitable for cultivation. In fact, the rapid increase in ploughing and in the area ploughed is in some places causing alarm. It merely enables larger areas to be grown temporarily with commercial crops, and the inevitable result is more serious soil erosion and a shortening of the period of bush fallow.

The introduction of draught cattle into the agricultural practice of Africa must, however, be a slow process. At present it is only feasible in areas free from tsetse fly, but as the work of exterminating the fly progresses, doubtless new areas will become available. Probably the only method of preventing them from again becoming fly-infested areas is the development of a native system of mixed farming. One finds that in areas where there is now dense European settlement, and which were previously fly-infested, the fly has now disappeared, and the same result is probable if the problem of settling natives on cleared areas is tackled in the right way.

If the benefits which tropical Africa derives from European influence are not to be ephemeral, the present exploitation of the

fertility of the land, whether by agricultural or pastoral tribes, must be checked. Research should concentrate on problems such as those briefly referred to in this article, and the closest co-operation possible between the Departments of Agriculture and Animal Husbandry and the Administrative Service must follow if the results of such research are to be of any material value in checking the huge capital losses now being incurred.

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AN INEXPENSIVE METHOD OF SELFING COTTON FLOWERS

BY

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IN cotton breeding stations where an extensive breeding programme is planned or large quantities of selfed seeds are to be secured, the cost of selfing is an important consideration. Of the several methods described on pages 44-49 of Volume VI. of this journal, the use of adhesives suggests itself as the cheapest.

It is important that any adhesive, if it is to be efficient, should dry quickly after the application and be firm enough to withstand the pressure of the unfurling of the petals. Also it should not absorb moisture from dew nor melt under the sun's rays.

Bearing these points in mind, several adhesives like gum, glue, Canada balsam, rubber solution, egg albumin, mixture of lime and jaggery, mixture of casein and lime, and potters' clay were tried at the Cotton Breeding Station, Coimbatore. The present note records the method finally developed after numerous experiments. It consists in the use of moist clay to prevent the opening of the petals. The procedure is quite simple and as inexpensive as it is efficient, and at the same time it is quicker than ordinary methods.

The actual mode of operation is as follows: Ordinary potters' clay is worked with water to a semi-liquid consistency and then smeared on to the tip of the floral bud. This is done a few hours before opening, and to a width of $\frac{1}{4}$ inch. In localities where the morning dew is not heavy and the buds are of small size, as in *G. indicum*, this operation has proved to be quite successful. In other cases, as in *G. hirsutum*, a slight modification was found necessary, since mere smearing with clay was not sufficiently strong to keep the petals from unfurling, and some kind of reinforcement, therefore, was obviously needed. A few cotton fibres dipped in the clay solution and stuck on to the flower-tips served the purpose quite well (Fig. 1).

The same device was also adopted for the marking of selfed bolls. A few more fibres were dipped in clay and wound round the pedicels (Fig. 2). They remained intact till the bolls were picked.



FIG. 1. SELFED BUD: OPENING PREVENTED BY THE
USE OF FIBRES DIPPED IN CLAY.



FIG. 2. - BOLL MARKED BY FIBRES MIXED WITH CLAY
AND WOUND AROUND STALK.

When selfing had to be performed on a larger scale, marking was dispensed with. Every evening, by which time all the missed buds had opened, a responsible person was deputed to go round each plant and clip off all such flowers.

The above method has been in use on a number of stations in the Madras Presidency since 1930 onwards. In all places it has been found to be 100 per cent. efficient and at the same time to reduce the cost of selfing by 50 per cent.

An attempt was made to compare the different methods of selfing. The same persons carried out the work in each case. The results obtained are set forth in the following table:

TABLE I.

<i>Method of Selfing.</i>						<i>Number of Buds Selfed per Hour, including Marking.</i>
Needle and thread	...	...	...	...	...	150
Rings	...	...	...	...	...	200
Gum	...	...	...	...	...	250
Clay	...	...	...	...	...	300

The numbers given in the table are the output for the first hour of working only. It may be mentioned that even when one has to work for several hours at a stretch the average rate under this system was never less than 200. Similar estimates under the other systems were not actually worked out, but there can be little doubt that with them also a corresponding decrease in rate would occur as a result of fatigue.

It is a matter of common experience that in cottons hybrids display great vigour and high productivity. Comparative yield-tests conducted at Coimbatore with the F_1 population, and with their parents, indicated that an increase of more than 40 per cent. could easily be obtained from the hybrid plants (*vide* Table II.). This increase is seldom reached by high-yielding strains isolated by normal plant breeding methods. But the process of emasculation incidental to crossing is so technical and time-consuming that the ordinary farmer is precluded from using hybrid seeds for sowing on a wider scale. If only a cheap and fool-proof method could be devised, it is likely that many of the progressive farmers would take it up readily without any misgiving.

Attempts were therefore made to find out if the use of moist clay could be extended for the emasculation of flowers and the raising of F_1 seeds on a commercial scale, and they met with a good measure of success.

TABLE II.—YIELD OF SEED COTTON IN OUNCES.

AREA OF EACH PLOT=1/100 ACRE.

	Number of Repetitions.						Average per Plot.
	1	2	3	4	5	6	
<i>G. indicum</i> parent ...	54.25	35.75	38.00	44.25	46.75	37.50	42.75
<i>G. herbaceum</i> parent ...	19.75	18.50	10.25	20.75	23.00	25.75	19.51
F_1 (<i>indicum</i> ♀) ...	65.00	57.50	44.75	56.50	71.75	60.25	59.29
F_1 (<i>herbaceum</i> ♀) ...	59.25	56.50	52.25	63.25	56.25	46.50	55.67
S.D. (mean) ...	—	—	—	—	—	—	±2.6

The author is indebted to Mr. R. Balasubramania Ayyar for the above figures.

G. herbaceum and *G. indicum* were chosen for this trial, and reciprocal crosses were sought to be effected between the two by the use of moist clay for emasculation. A few hours prior to the flower-opening the petals were removed by gentle tearing by the fingers, and the clay solution was smeared on the staminal column, taking care that anthers only were completely covered with the clay. Such an operation, if done with a little care, was found to prevent the dehiscence of anthers. The pollen of the other plant was then dusted on the stigma at about 10 a.m. With the pollen of a single flower, stigmata of four or five flowers were pollinated. In the evenings the flowers that escaped the treatment with clay were nipped off. In all cases bolls developed normally.

The seeds obtained by this process were sown separately the following year and the numbers of hybrids were counted. It was found that only 8 per cent. of the plants were non-hybrids when *G. herbaceum* was the stigmatic parent, while 21 per cent. were non-hybrids when *G. indicum* was the female parent. The divergence in the frequency of the parental types among the hybrid populations appears to be due to the differences in the lengths of their styles. Whenever the longer-styled variety was used as the stigmatic parent, the proportion of hybrids was higher.

The cost of production of F_1 seeds according to the above method worked out at Rs. 4½ to 5 per acre. The extra yield obtained by the use of F_1 seeds left a margin of Rs. 7 per acre—which would mean a profit of 20 per cent.—after allowing for the high cost of seed.

OVER-PRODUCTION OR UNDER-CONSUMPTION ?

BY

H. MARTIN LEAKE, M.A., Sc.D.

THE superabundance of agricultural produce of all sorts with which the world is at the moment cluttered up has given rise to two schools of thought: a school which holds that the phenomenon is due to over-production, and a school which holds that it is a case of under-consumption. From the practical steps which are now being taken, such as the actual destruction of produce—as with coffee in Brazil—and the control of production—as with rubber, tea, and cotton (in America)—it might appear that those responsible for national policy the world over belong to the former school. That inference, however, is, perhaps, hardly justified; a reduction in the rate of production may be the readiest method of countering the evils arising from a temporary maladjustment between consumption and production pending a solution of the more complex problem of stimulating the former. The two problems, the near and the more distant, require to be kept distinct. It is this more distant problem with which the business man and the administrator are intimately concerned: the business man because he has to decide whether he will be able to sell his produce at a profit if he invest capital in agricultural development in the tropics, the administrator because he is responsible for colonial policy and for that advancement of the peoples which can only be effected by increasing the volume of exchangeable agricultural produce and by finding a market for this produce. To both, the question of whether the present phenomenon of over-production is a temporary or a permanent one is very pertinent.

That there exist at the present time, and concurrently, both over-production and under-consumption is too evident to require argument; the destruction of produce already harvested and the limitation of production in other cases afford ample evidence of the former; the obvious inability to satisfy many reasonable desires is a matter of personal experience to practically all humanity. The phenomenon has been well summed up in the phrase, "Poverty in plenty." The facts are not in question. The question to which the answer is less clear is, whether, given capacity to purchase, production would

still exceed consumptive demand. It is a subject worthy of brief consideration for, if that be so, the outlook is dark indeed.

The protagonists of the under-consumption school hold that the potential capacity for consumption is unlimited, for it will not be satisfied till every bushman can, for instance, possess his own motor. There is no doubt a considerable element of truth in this contention, but, from the realistic aspect, it neglects one very important factor—time. Few, if any, bushmen at the present time have any desire to own a car and if presented with one would not say “thank you”; if they were provided with a four-course dinner, they would probably suffer from indigestion. The process of educating the large masses of backward humanity to appreciate the refinements of civilization is a matter of time, of generations, for backward man cannot absorb civilization too rapidly without evil effect. The practical aspect of the question is, therefore, dual: Is productive capacity greater than demand if the present restrictions on consumption were removed, and has it a capacity for expansion adequate to meet the growing consumptive capacity of a world gradually adopting a higher standard of life? That is the question to which an answer is here sought.

Readers of this Journal are interested in the application of the answers to these questions to the case of cotton. But it is hardly possible to limit the discussion to one crop. Cotton is an agricultural product, and it is becoming more and more apparent that agriculture generally, and not a single crop, must be taken as the unit; for any organization based on a single crop is fundamentally unsound, unsound both agriculturally—because it neglects the need for rotations, particularly important in the case of a seasonal crop like cotton—and financially, because it is never safe to have all one's apples in one basket. But even with this limitation it is necessary to draw a distinction between two groups, crops like cereals which provide the sustenance of man, and crops like rubber and cotton which enter as components of his external needs. The market for produce of the former group is necessarily less flexible than that of the latter. In the one case it is largely a question of substitution of one product for another, and there are definite limits to the application of the advertisement appeal to “Eat more——”; in the other there is no such limit. Though it will be long before each member of the human race demands his or her own cake of soap, new uses for oils are constantly being discovered. Cotton falls into the latter group with more flexible markets; it is, moreover, a tropical crop, which still further restricts the scope of the enquiry.

What, then, are the potentialities for increased production of

tropical agricultural produce? Such an increase can be visualized as arising in two ways: expansion of area under cultivation and increased outturn per unit area. That there is an indefinite, but very large, area in the tropics awaiting development is undoubted. Rapid strides have been made in the opening up of tropical countries in the course of the present century, and if the pace has slackened in recent years, there is little doubt that it could be speeded up. It is well within the capacity of industry to provide all the material requirements for such a development, the rolling stock and motor transport, the latter of which, used for feeding the present railways, has alone enormously extended the area now lying within the range of economic development. The limitations are twofold: the absence of an adequate population, and inability to see a secure return on the capital expenditure involved. Few can doubt that, with the assurance given by the better prices which would follow any firm tendency for consumption to outstrip production, capital in any needed quantity would be forthcoming. Lack of capital will offer no bar to progress. The effectiveness of population as a limiting factor is less easily forecasted. But population is not only becoming more mobile, it is becoming less essential with the growing use of mechanism in the fields. If a personal expression of opinion may be permitted, it is that population will exercise little effect, and that production can readily expand to meet any demand likely to arise whether from removal of the present restrictions on consumption or from the improvement of the standard of life.

The second possibility, increase of outturn per unit area, cannot be dismissed so briefly. The potential yielding capacity of any crop or of any area is an abstraction in which the practical man has hitherto had little interest; his concern has been with the yields obtainable in actual practice. The scientist, too, has been accustomed to estimate his improvements, and to congratulate himself accordingly, against present outturn and not against a theoretical maximum, a process which would not be so conducive to his self-esteem. The theoretical maximum yield is an abstraction derived from calculations of a highly technical character into which it is, fortunately, unnecessary to enter, for the underlying idea is simple. Crop yield is the result of growth, and it is customary to think of that growth as limited by one or other of the conditions under which it takes place. The whole art of manuring illustrates this, for it is the art of determining which of the various plant foods are responsible for restricting growth by deficiency, and of supplying that deficiency. This line of thought leads to the question of what happens when

each factor capable of limiting growth is supplied in adequate quantity? Clearly a gigantic plant will not result; the most well cared for and highly nurtured baby will not thereby become a giant. There arises, therefore, the idea of a restrictive force innate in the plant itself which limits growth and, consequently, yield. It is this potential yield when all external restrictive forces are removed which constitutes the theoretical maximum.

This theoretical maximum, though of small practical importance at the present time, will serve to illustrate the present question. For cotton it has been determined as 4.6 bales per acre. Among others for which the acreage maximum yields have been determined are: wheat, 171 bushels; maize, 225 bushels; beet, 53 tons; sugar cane, 185 tons. It is only necessary to compare these with present actual yields—cotton 0.32 bale (America); wheat, 32 bushels (England); maize, 26 bushels (America); beet, 10 tons (England); and cane, 53 to 15 tons according to country—to see what an enormous scope remains for the improvement of yield.

These figures are so startling that two thoughts naturally arise: Is the method by which these figures are obtained beyond question and, if so, is there any reason for supposing that they will be realized in practice? With regard to the first of these questions, the writer at least admits of some hesitation in accepting the method as above criticism. Admittedly it is an approximation, but an actual record of 186 tons of cane obtained in Australia would appear to justify the conclusion that, if in error, the method errs in the direction of underestimation. In maize, too, the maximum yield of 225 bushels has been recorded. With regard to the second query, it is evident that nothing approaching these maxima will be obtained in general practice and it is unnecessary to consider that possibility seriously. But the present scale of production is so small that a very moderate increase would be sufficient to alter the whole agricultural outlook. The following figures expressing the standard yield as percentage of the maximum indicate this: wheat, 15 (England); maize, 11 (America); beet, 15 (England); sugar cane, 29 (Java); cotton, 9 (America). Indications are not wanting that such moderate increases are well within practical range. Science is relatively a newcomer to the field and has much to learn, and still more to accomplish in creating an effective link with practice; but it has already done much. Hawaii, perhaps, affords the most striking example, for, with a highly developed technical organization attached to the sugar industry, it has doubled the production of sugar per acre in ten years and the trend is still upwards. Agriculture in the U.S.A.

affords another example which, if less dramatic, is none the less pertinent. In this vast country expansion first took the form of a gradual thrust westwards with exploitation of virgin fertility. That phase has passed and the present trend is towards an intensive agriculture in the east. In the eastern states the trend is definitely upwards, and increases of 50 per cent. on earlier standards are not exceptional. This by no means indicates the practical possibilities, for the returns include those of good, bad and indifferent farmers. A clearer indication of what is possible will appear from the following recorded yields on a field scale: wheat, 117 bushels; maize, 174 bushels; beet, 42 tons; cotton, 3.5 bales. Nor is this the end of the story. These maxima are calculated for the individual varieties known to be high yielders. Yield capacity is, however, a varietal characteristic, and meanwhile the plant-breeder is at work attempting to produce new varieties with a capacity for producing even higher yields.*

The above remarks are of general application to tropical agriculture, and it is not possible to argue from these generalities to a particular crop. Each crop must be considered on its own merits. The cotton industry is severely depressed, and the causes of this depression are various. In countries with an old-established industry, the depression is partly due to competition from the expanding industry in other countries; but this cause does not enter into the present discussion, nor does the fact that competitive substitutes, such as rayon, are being developed. The fact that is pertinent is that the world production of cotton has hardly altered since 1914; the normal increase has not been realized, and consumption obviously dictates the pace.

Whether the cause of this failure of production to increase be lack of general purchasing power—in which case a recovery in world conditions will re-establish it—or whether it be competition of substitutes—in which case some alternative use for cotton such as the paving of roads may re-establish it—the question arises whether production can keep pace with the increasing demand. The answer is important to all those engaged, or contemplating engagement, in the production of cotton.

In view of what has been said, there can be little doubt that the potential productive capacity of the world is enormous; to mention two instances, in India with its new Canal Colonies and in Brazil there lie large areas as yet partly developed or lying completely

* The whole subject of potential yield and its implications is discussed in *Reshaping Agriculture*, by O. W. Willcox.

undeveloped; America (U.S.A.) itself has a vast potential capacity. An examination of the detailed figures of production* brings out the striking fact that, while total production has remained fairly constant, the relation between American and outside growths has markedly changed, the latter now forming well over 50 per cent. of the total production. Partly this is due to enforced restriction of planting in America, but partly it is the result of a real increase of the production of outside growths, for which India and Brazil are mainly responsible. There is here evidence not only of American capacity to expand, but of expansion in other countries only awaiting higher prices (*i.e.*, consumption) to call it forth. Further indication that it is price and not producing capacity which is restricting production is given by the clear tendency shown by these figures for a bumper American crop to be followed by a reduction of outside growths. It would appear that production is capable of meeting any reasonable increase of consumption by expansion of area. Moreover, expansion of area may be a rapid process, how rapid the sugar industry during the war well illustrates. With the demand for sugar caused by the reduction of the area under beet during the war, the Cuban production of sugar rose from under 3 million to 5.8 million tons, a development requiring not only expansion of area, but a heavy capital expenditure for factories such as would not be incurred in the case of cotton.

Thus far, expansion of area has been considered; there remains the question of increased yield. The figures given above sufficiently indicate the potentialities in this direction. But their realization is likely to be slow for the reason that the necessary control of cultivation is secured with difficulty in a crop mainly raised under a peasant system. Cotton is a temperamental crop and its yield is largely influenced by seasonal variations; there appear to be no figures indicative of a material increase of yield sufficiently large to be recognized among these seasonal variations. That they will be realized in time can hardly be doubted. From the world aspect it is undoubtedly desirable that production should be stabilized, but, unfortunately, it is not the world aspect but that of the individual producing unit—whether this be the small peasant or the plantation owner—which controls production. As matters stand, each unit will be guided by the prospect of realizing a profit on his crop. That this consideration applies to the case of capitalistic farming is obvious, for, in such cases, the price likely to be realized by the produce is

* I am deeply indebted to Prof. Todd for supplying the figures on which these observations are based. The inferences are, however, my own.

the prime consideration, especially when the desirability of opening up new areas is in question. That it is equally true in the case of the peasant is less obvious but well shown by the fact that the area of unirrigated cotton in Northern India is closely correlated with the cotton : wheat price ratio at the time of sowing—that is, that the Indian peasant acutely judges the relative benefits of the two crops. The paradox thus arises, that while the world condition calls aloud for stabilization of production, the individual exigencies compel effort to produce more by raising the productive capacity of the unit area. There can be no question that the more intimate pressure will dominate. So long as Nationalism remains, the administrator of a territory, the wealth of which lies in agricultural production, is compelled to use every device to raise the productive capacity of the land. The same argument applies with even greater force in the case of the plantation manager. World interests may demand that the scientist be sacked; fortunately for him and for the unemployment figures, the dominant force will compel his more intensive employment leading to increasing yields.

It is not possible to do more than touch on the methods by which this increase is being sought. At the present time cotton is being intensively bred in many countries and new varieties are constantly appearing. As far as these owe their favourable reception to yielding capacity and not quality, it has to be recognized that the result, though in practical effect the same, may be due to an increase in the potential yielding capacity—a raising of the maximum yield rather than a reaping of a larger percentage of the maximum. But it is probable that more can be accomplished by direct improvement of the conditions of growth and cultivation. Cotton is, as has been said, a temperamental plant, but will subsist under very adverse conditions. In consequence too little attention has, in general, been paid to these conditions of growth. Considerations of quality compel the cultivation of American forms wherever possible and these lack the hardiness of the Asiatic forms. Pending the imposition by breeders of the hardiness of the Asiatic on to the American cottons—in the manner in which the hardiness of the Indian canes has been imposed on the Noble canes with such marked results—much remains to be done to improve the conditions of growth, particularly in Africa. It is impossible to study the history of cotton in most countries without being struck by the part played by disease in limiting the crop. Disease may be unavoidable, the elephant may devastate the crop, and the strongest man fall a victim to cholera, but the first line of defence against disease is to ensure health. In this

connection one point only can be emphasized: the part played by humus, an account of which has recently been given by Howard.* The Indore process for producing supplies of humus, to which he refers, was evolved by him at Indore, the centre of a cotton-growing tract, and the results obtained by him with cotton are truly remarkable.

* In a lecture to the Royal Society of Arts, November 13, 1935.

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COTTON STATISTICS

BY

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World's Crops.—The result of the more or less final revision of the 1934-35 crops is to raise the total production of Outside Growths to a still higher figure than when this table last appeared in July, viz. 14,933,000 bales against the American crop of 10,611,000 bales (including linters), so that Outside Growths form the record proportion of 58·5 per cent. of the world's total production. The upward revision is very widespread and includes new record figures for Brazil, Peru, the Argentine, China, Japan and Korea (including Manchuria), Russia, Turkey (included in "Asia Minor and Europe"), Sudan, West Africa and Belgian Congo (included in "Africa, non-British"). The important point is that so far as the estimates are available for 1935-36 they show no sign of any setback in the steady expansion of Outside Growths. For most of the important crops some statistical information is now available as a basis for the estimates, though in other cases our estimate is largely based on last year's figures, but on the whole these estimates are conservative. It must be noted, however, that the increase in the estimated total production of Outside Growths for the coming season is almost exactly the amount of the estimated increase for India, and in this case the estimated increase is very much less than is indicated by some of the private reporters. Ralli's estimate, for example, is 7,434,000 bales against 6,810,000 at the same stage last year, but this was finally revised to 5,731,000. On the whole, however, the conclusion is that there is no reason to expect any reduction in Outside Growths and the total figure will depend largely on the outcome of the Indian crop.

American Crop.—With regard to the American crop the season is already sufficiently advanced to show that its general character is likely to stand out in marked contrast to what has come to be regarded as normal in say the last ten years. Every succeeding Bureau since August has seen a reduction of the indicated crop figure, with the result that the latest estimate is only 10,794,000 bales against 11,798,000 in August, while the average yield has been reduced from 198·8 lb. to 188·0 lbs. per acre. It would have been even less but for the fact that the acreage was reduced in December.

Egyptian Cotton.—In the table of Egyptian area and crop by varieties given in the October issue we were only able to give the area figures for 1935, which, it will be remembered, showed a further reduction. In spite of this the Government's October estimate gave a total figure almost exactly the same as at the same stage last year, but the December estimate was raised still further to 8,445,000 kantars including Scarto. The estimate of the Alexandria Bourse authorities published in December was 8,100,000 kantars, but it is not clear whether this includes Scarto or not.

World's Carryover of Egyptian Cotton.—This table now includes the World's Carryover at the end of last season, which, it will be seen, showed a reduction of nearly 1,500,000 kantars, the end of season total being only 3,568,000 kantars. We have to go back to July, 1928, to get a lower figure, while the record high figure was 6,959,000 kantars at the end of July, 1931.

World's Consumption.—In the October issue we gave preliminary figures of this season's statistics of the International Federation, including an estimate of our own (based on the five years' average) of the consumption in Germany of which the Federation gave no figures at all. Since then, however, Garside has published certain details of his estimate of the German consumption, which, as will be seen from the following summary, was very much less than the five years' average, especially for American.

GERMANY'S COTTON CONSUMPTION, 1934-35.

			<i>Five Years' Average.</i>	<i>Garside.</i>	<i>U.S.D.A.</i>
American	...	...	896	376	485
Indian	...	...	178	568	173
Egyptian	...	...	100		111
Sundries	...	...	94		598
Total	...	...	1,268	944	1,367

Now the Bureau of Agricultural Economics in Washington has published an estimate, also included in the table, the figures of which are substantially higher all round than Garside, but bear out our expectation of a reduced consumption of American offset by a much larger consumption of Outside Growths. As we believe that the Department of Agriculture's figures are the nearest approach we are likely to get to a reasonable estimate, we have used them instead of the five years' average in our table of World's Consumption, which we therefore reprint with these alterations and also including sundry minor revisions which the Federation have since made in their figures. It will be seen that these alterations reduce our original figure of the

world's consumption of American from 11,748,000 bales to 11,353,000, while Sundries have been increased from 6,975,000 bales to 7,480,000. The changes in Indian and Egyptian are very slight. The result is that the final figures make the comparison American 11,353,000 bales, Outside Growths 14,447,000. The total consumption of all kinds, 25,800,000 bales, is the highest since 1928-29, and that was very close to the record consumption of 26,139,000 bales in 1926-27.

In regard to these figures of consumption of Outside Growths it must be remembered that they relate to mill consumption only and do not include the very substantial figures of purely domestic consumption by the hand-loom industries of the world, especially in India and China. There is of course no statistical information available as to this consumption, but we used to estimate it at about 2,000,000 bales a year. If that is anything like correct it will be seen that the world's total consumption of Outside Growths last season was again substantially higher than the production according to the table of the world's crops. It is unfortunately impossible to get any reliable statistics of the World's Carryover of Outside Growths, but there can be little doubt that the excess of consumption over production has been going on for some time now at a rate which cannot be maintained.

As regards the world's consumption for the new season so far as it has gone the U.S. figures make quite a good comparison with the corresponding months of last season, but it must be remembered that in September, 1934, the American industry was undergoing a strike which cut consumption to very low figures. As to the world's consumption of American, and also of Outside Growths, Garside estimates these figures for the first three months of the season at American 2,900,000 bales against Outside Growths 3,533,000. There is no evidence yet in these figures of any marked swing back of consumption from Outside Growths to American.

Prices.—It will be seen from the first table of Futures prices that after a substantial decline from the high level of August before the first Bureau, prices made a definite recovery in October largely as the result of the war scare, and in November touched a new high level for the season after the unexpected crop reduction in the November Bureau. Relative spot prices of Outside Growths also marked new high levels in November. The Sakel premium is the highest since August, 1931.

WORLD'S COTTON CROPS.

(BALES OF 500 LBS.—000's.)

	1930-31.	1931-32.	1932-33.	1933-34.	1934-35.	1935-36. <i>Estimates.</i>
U.S.A. Lint	13,932	17,096	13,002	13,047	9,636	10,734
Linters	986	1,067	912	982	975	975
Total	14,918	18,163	13,914	14,029	10,611	11,709
Mexico	174	203	99	255	216	208
Brazil	471	575	448	969	1,332	1,500
Peru	265	228	237	271	321	300
Argentina	136	165	146	206	260	250
Other South American	57	46	39	68	60	60
India*	5,224	4,007	4,657	5,068	4,807	5,500
China	2,386	1,733	2,195	2,633	3,125	2,600
Japan and Korea ...	147	99	133	217	222	250
East Indies, etc. ...	18	15	14	14	14	14
Russia	1,589	1,846	1,776	1,846	1,937	2,000
Persia	64	107	79	100	100	100
Iraq, Ceylon, etc. ...	3	1	†	†	2	2
Asia Minor and Europe	120	131	68	191	248	351
Egypt	1,655	1,271	991	1,715	1,511	1,689
Sudan	96	188	110	126	213	200
East Africa (British)	166	183	269	273	237	250
South Africa (British)	8	3	2	3	4	4
West Africa (British) ...	15	5	20	23	44	44
Non-British Africa ...	125	96	121	155	230	230
West Indies (British) ...	4	2	2	3	3	3
West Indies (Others) ...	21	31	26	23	30	30
Australia, etc. ...	10	4	11	18	17	17
World's Total ...	27,672	29,102	25,357	28,206	25,544	27,311
Outside Growths ...	12,754	10,939	11,443	14,177	14,933	15,602
Per cent. on Total ...	46·1	37·6	45·1	50·3	58·5	57·1

* Government estimate, 400 lb. bales.

† Less than 500 bales.

AMERICAN CROP (EXCLUDING LINTERS).

	1929-30.	1930-31.	1931-32.	1932-33.	1933-34.	1934-35.
Acreage planted (000's)	44,458	43,339	39,109	36,542	40,852*	27,883
Acreage harvested ...	43,242	42,454	38,705	35,939	29,978	26,987
Crop (running bales)...	14,548	13,756	16,629	12,710	12,664	9,472
Yield per acre (lbs.)...	164·1	157·0	211·5	173·3	208·5	170·9
Season's average spot price (Liverpool—pence per lb.) ...	9·09	5·71	4·82	5·62	6·02	6·93

PROGRESS OF THE SEASON 1935-36.

	<i>August.</i>	<i>Sept.</i>	<i>Oct.</i>	<i>Nov.</i>	<i>Dec.</i>	<i>March.</i>
Acreage planted ...	29,166	29,166	29,166	29,166	27,872	—
Acreage harvested ...	28,480	28,652	28,652	28,652	27,331	—
Crop (500 lb. bales) ...	11,798	11,489	11,464	11,141	10,734	—
Yield per acre (lbs.)...	198·3	192·0	191·5	186·1	188·0	—

* Less 10,396,000 acres special abandonment.

EGYPTIAN CROP.

	1930-31.	1931-32.	1932-33.	1933-34.	1934-35.	1935-36. (Decr.)
Area (feddans, 000's) ...	2,082	1,683	1,094	1,804	1,732	1,669
Crop (kantars, 000's):						
Alexandria adjusted arrivals ...	7,947	6,563	5,050	8,438	7,540	8,100
Government figures*	8,276	6,357	4,956	8,575	7,555	8,445
Average yield (kantars per feddan)* ...	3.97	3.78	4.53	4.75	4.36	5.06

Season's Average Spot Prices (Liverpool—Pence per Lb.).

Sakel ...	9.06	6.80	7.79	8.05	8.52	—
Percentage on American	33.6	41.1	38.6	33.7	22.9	—
Uppers ...	6.86	5.68	7.01	6.64	7.57	—
Percentage on American	20.1	17.8	24.7	10.3	9.2	—

* Final revised figures, including Scarto.

WORLD'S CARRYOVER OF EGYPTIAN COTTON

(KANTARS 000's.)

End of	Stock and Afloat.		U.S.A.		Alex- andria.	Monthly Totals.	Federation. Other Mill Stocks.	Half- Yearly Totals.*
	U.K.	Conti- nent.	Mills.	Ware- houses.				
1929, July ...	510	150	449	197	1,677	2,983	1,260	4,243
1930, January	585	270	353	202	3,403	4,813	1,335	6,148
July ...	353	135	483	245	3,616	4,834	1,297	6,131
1931, January	630	293	341	129	5,349	6,742	1,185	7,927
July ...	600	165	212	108	4,456	5,541	1,418	6,959
1932, January	1,013	248	145	63	5,521	6,990	1,447	8,437
July ...	885	203	161	180	3,780	5,209	1,553	6,762
1933, January	878	218	134	169	4,255	5,654	1,425	7,079
July ...	742	202	131	143	2,228	3,446	1,635	5,081
1934, January	1,507	337	143	106	3,157	5,250	1,687	6,937
July ...	1,132	248	174	135	1,491	3,180	1,868	5,048
1935, January	968	435	134	100	2,230	3,867	2,108	5,975
February	952	465	130	112	2,171	3,830	—	—
March	870	420	129	116	2,081	3,616	—	—
April ...	848	353	124	121	1,866	3,312	—	—
May ...	705	323	121	122	1,495	2,766	—	—
June ...	653	308	121	122	1,045	2,249	—	—
July ...	533	285	129	110	546	1,603	1,965	3,568
August	420	233	124	99	443	1,319	—	—
September	353	165	110	86	689	1,403	—	—
October	525	518	106	73	1,318	2,540	—	—
November	675	577	—	—	—	—	—	—

Figures in *italics* to distinguish between mid-season and end of season.

WORLD'S CONSUMPTION OF COTTON.
(FROM THE STATISTICS OF THE INTERNATIONAL FEDERATION.)
(Running Bales, 000's—Excluding Linters.)

Variety.	Season.	U.K.	Continent.	U.S.A.	Asia.	Others.	Totals.
<i>American.</i>	1929-30	1,474	4,055	5,803	1,427	256	13,015
	1930-31	991	3,242	5,084	1,345	239	10,901
	1931-32	1,342	3,343	4,744	2,636	251	12,316
	1932-33	1,400	3,836	6,004	2,655	276	14,171
	1933-34	1,461	3,976	5,553	2,238	306	13,534
	1934-35	1,049	2,782	5,240	1,997	285	11,353
<i>Indian.</i>	1929-30	188	1,375	61	4,403	60	6,087
	1930-31	252	1,215	43	4,318	35	5,863
	1931-32	183	727	21	3,834	23	4,788
	1932-33	126	600	16	3,455	23	4,220
	1933-34	234	844	14	3,638	42	4,772
	1934-35	342	889	22	4,501	18	5,772
<i>Egyptian.</i>	1929-30	301	415	137	58	26	937
	1930-31	242	420	70	96	25	853
	1931-32	301	480	53	120	26	980
	1932-33	301	442	58	104	29	934
	1933-34	366	515	69	119	39	1,108
	1934-35	362	552	55	185	41	1,195
<i>Sundries.</i>	1929-30	502	2,044	51	1,825	740	5,162
	1930-31	479	1,984	42	1,648	711	4,864
	1931-32	560	1,730	26	1,133	786	4,235
	1932-33	421	1,797	32	1,922	856	5,028
	1933-34	409	2,137	33	2,154	964	5,697
	1934-35	754	3,099	19	2,456	1,152	7,480
<i>All kinds.</i>	1929-30	2,465	7,889	6,052	7,713	1,082	25,201
	1930-31	1,964	6,861	5,239	7,407	1,010	22,481
	1931-32	2,386	6,280	4,844	7,723	1,086	22,319
	1932-33	2,248	6,675	6,110	8,136	1,184	24,353
	1933-34	2,470	7,472	5,669	8,149	1,351	25,111
	1934-35	2,507	7,322	5,336	9,139	1,496	25,800

U.S. CONSUMPTION OF COTTON BY VARIETIES.
(RUNNING BALES 000's: "FOREIGN" IN EQUIVALENT 500-LB. BALES.)

1933-34.	Total.	Daily Rate.	Upland.	American Egyptian.	Egyptian.	Other Foreign.	Linters not Included.
May ...	519.8	22.8	507.1	1.0	7.4	4.3	63.9
June ...	363.4	17.3	352.9	1.0	6.3	3.2	55.0
July ...	359.4	17.1	349.7	0.6	6.1	3.0	63.0
1934-35.							
August ...	420.9	18.3	409.4	0.8	7.8	2.9	61.2
September ...	296.0	15.0	289.3	0.3	4.5	1.9	54.7
October ...	520.3	22.9	506.6	0.9	10.4	2.5	57.4
November ...	477.1	22.2	465.1	0.8	8.5	2.7	51.4
December ...	413.5	21.8	403.5	0.8	6.8	2.5	52.1
January ...	546.8	24.0	534.3	0.9	8.7	2.9	61.8
February ...	478.3	24.2	467.1	0.7	7.3	3.1	62.8
March ...	481.1	22.9	469.6	0.8	6.9	3.8	66.8
April ...	462.8	21.3	450.8	1.1	6.8	4.1	70.3
May ...	469.2	20.6	458.8	1.4	5.7	3.4	65.5
June ...	385.9	19.3	376.8	1.3	4.6	3.2	61.9
July ...	391.8	17.8	382.0	1.3	4.7	3.8	62.1
1935-36.							
August ...	408.4	18.6	397.9	2.0	4.7	3.9	57.9
September ...	449.1	21.4	437.6	1.8	5.5	4.2	61.1
October ...	552.2	24.0	538.5	2.0	6.4	5.3	67.1

HIGHEST AND LOWEST FUTURES PRICES.

1933-34.	<i>American.</i>				<i>Egyptian (Liverpool).</i>			
	<i>New York.</i>		<i>Liverpool.</i>		<i>Sakel.</i>		<i>Uppers.</i>	
	<i>High.</i>	<i>Low.</i>	<i>High.</i>	<i>Low.</i>	<i>High.</i>	<i>Low.</i>	<i>High.</i>	<i>Low.</i>
May ...	11-59	10-70	6-05	5-57	8-37	7-88	6-63	6-14
June ...	12-52	11-61	6-55	5-94	8-48	8-22	6-98	6-55
July ...	13-35	12-03	6-97	6-28	8-60	8-10	7-31	6-75
1934-35.								
August ...	13-84	12-97	7-23	6-77	8-71	8-29	7-54	7-19
September	13-43	12-35	7-00	6-57	8-65	7-87	7-59	7-02
October ...	12-53	11-96	6-70	6-43	8-21	7-65	7-19	6-74
November	12-66	12-02	6-80	6-45	8-85	7-99	7-58	6-97
December	12-72	12-44	6-89	6-64	8-79	8-46	7-64	7-38
January ...	12-75	12-27	6-94	6-75	8-72	8-51	7-75	7-56
February	12-73	12-26	6-88	6-68	8-58	8-36	7-58	7-38
March ...	12-49	10-25	6-97	5-95	8-61	7-69	7-65	6-70
April ...	11-90	10-83	6-54	5-97	8-16	7-86	7-34	6-87
May ...	12-19	10-95	6-56	6-29	8-16	7-86	7-47	7-16
June ...	11-58	10-56	6-17	5-74	7-91	7-62	7-03	6-66
July ...	11-80	11-30	6-23	6-12	7-89	7-67	7-10	6-97
1935-36.								
August ...	11-60	10-31	6-22	5-63	7-86	7-58	7-04	6-42
September	10-81	10-31	5-97	5-52	8-01	7-48	6-82	6-38
October ...	11-27	10-54	6-21	5-77	8-42	7-78	6-87	6-51
November	11-97	10-86	6-54	6-07	9-51	8-44	7-77	6-82

Maximum and minimum figures in each season are given in italics.

LIVERPOOL SPOT PRICES OF AMERICAN WITH OTHER VARIETIES
AS PERCENTAGES (LAST FRIDAY OF EACH MONTH).

1933-34.	<i>American (Middling). Pence per Lb.</i>	<i>Indian No. 1 Fine Oomra.</i>	<i>West African (Middling).</i>	<i>Brazil Per- nam (Fair).</i>	<i>East African (Good Fair).</i>	<i>Tanguis (Good).</i>	<i>Uppers (F.G.F.).</i>	<i>Sakel (F.G.F.).</i>
May ...	6-20	75-2	99-2	95-2	108-9	120-2	107-6	135-8
June ...	6-84	73-2	99-3	95-6	107-3	118-3	102-8	122-1
July ...	6-97	72-5	98-6	96-4	106-5	117-2	104-0	122-0
<i>Season's average</i>	6-02	75-1	99-5	98-8	110-8	121-4	110-3	133-7
1934-35.								
August ...	7-11	70-5	99-3	96-5	105-6	116-2	105-1	122-9
September	6-91	69-8	99-3	96-4	106-5	116-6	103-9	121-7
October ...	6-92	68-1	98-6	95-7	107-2	114-5	105-2	118-8
November	6-96	70-7	98-1	95-3	106-8	114-7	108-8	129-3
December	7-20	73-8	98-2	95-4	107-9	113-5	109-4	124-2
January ...	7-08	77-5	98-6	95-8	109-9	113-4	112-6	127-1
February	7-10	77-5	99-3	96-5	110-6	113-4	107-3	124-8
March ...	6-36	80-3	99-5	96-4	112-1	114-5	116-8	130-3
April ...	6-78	82-2	99-3	96-3	111-1	113-3	117-1	124-6
May ...	6-92	77-7	97-1	94-9	107-2	109-4	109-8	117-9
June ...	6-85	80-0	98-5	96-4	108-8	109-5	108-2*	117-2
July ...	6-80	81-8	100-0	96-3	106-6	108-8	108-5	118-7
<i>Season's average</i>	6-93	75-6	98-7	95-5	108-4	113-6	109-2	122-9
1935-36.								
August ...	6-21	76-0	100-0	95-2	106-4	108-9	114-2	128-0
September	6-40	78-6	100-0	96-1	105-5	109-4	112-3	133-1
October ...	6-47	84-7	100-8	98-5	109-3	117-0	107-3	140-8
November	6-59	87-3	101-8	99-5	111-7	119-3	120-2	153-9

New Contract.

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

1. The following reports have recently been received:

IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH: Ann. Rpt. for 1933-34.

INDIAN MERCHANTS' CHAMBER: Ann. Rpt. for 1934.

MYSORE: Agr. Calendar, 1933-34.

„ Ann. Admin. Rpt. of Dpt. of Agr., 1933-34.

PUNJAB: Rpt. of Operns. of Dpt. of Agr., 1933-34.

2. REPORT OF THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, 1933-34. (Pubd. by Manager of Pubns., Delhi, 1935). An account of the work of the year in connection with animal husbandry, agriculture, oil seeds, sugar, locust control, and soil investigations. The enquiry into the cost of production of cotton in the different Provinces and States, undertaken at the request of the Indian Central Cotton Committee, and partly financed by that body, was continued. At the outset most cultivators were antagonistic to the idea of the enquiry, but the difficulties were overcome, and the work proceeded smoothly.

3. INDIAN CENTRAL COTTON COMMITTEE. We have received from the Publicity Officer the following notice: *Development of Cotton Growing in the Bombay Presidency*—A précis of the Annual Rpt. of the Dept. of Agriculture, Bombay Presidency, for the year 1933-34, in which the following matters in connection with cotton are dealt with: seed supply; the extended cultivation of 1027 A.L.F. cotton, and the elimination of Goghari cotton; the control of the bollworm in Gujarat; breeding work to evolve wilt-resistant strains of cotton for the Khandesh and Broach districts; improvement in connection with cotton crop forecasting.

4. TECHNOLOGICAL REPORTS OF STANDARD INDIAN COTTONS. By N. Ahmad. (*Tech. Circs.*, Nos. 167, 188, 192, 193, 1934-35.) Copies have been received from the Indian Central Cotton Committee of reports on the cottons named below. The particulars include agricultural details, grader's report, fibre particulars, spinning tests, remarks and conclusions.

Gadag 1 (Dharwar-American).—Area under cultivation 90,250 acres. Yarns spun from this cotton are generally slightly neppy. The 1934-35 sample was suitable for 33's warp.

Punjab-American 4F.—Area under cultivation 741,080 acres. The 1934-35 sample was suitable for 27's warp.

Surat 1027 A.L.F.—Area under cultivation 356, 280 acres. Yarns spun from this cotton are inclined to be somewhat neppy. The 1934-35 sample was suitable for 34's warp.

Jayawant (Kumpla).—Area under cultivation 186,350 acres. Yarns spun from this cotton are practically free of neps. The spinning performance has remained remarkably uniform, the best results being obtained in the 1934-35 season, when the sample was adjudged suitable for 42's warp.

Cambodia Co. 2 (Cambodia 440).—Area under cultivation 71,870 acres. Yarns are inclined to be neppy, though a slight improvement noticeable since 1929-30. The 1934-35 sample was suitable for 30's warp.

5. SPINNING TEST REPORTS ON INDIAN COTTONS. By N. Ahmad. (*Ind. Cent. Cott. Comm. Tech. Circs.*, Nos. 174-187, 190-191, 194-197, 1934-35.) The circulars

contain the graders' report and spinning test results for Bailhongal, Broach, Karunganni, Tirupur Cambodia, Northern Cambodia, Farm Westerns, Westerns, Miraj, Nandyal, Surat, African Busoga, Kampala, and Hubli Upland cottons, and the report of the Standards Committee and spinning test results for Kalagin, Farm Westerns, Navsari, Upland, Dholleras, and Westerns cottons for the 1934-35 season.

6. COMBING OF GOOD QUALITY INDIAN COTTONS. By R. P. Richardson and N. Ahmad. (*Tech. Bull., Ser. A, No. 27*, Ind. Cent. Cott. Comm., 1935.) Gives the results of an extensive series of combing and spinning experiments carried out on four good quality Indian cottons with a view to examining the feasibility of using the better types of Indian cotton as substitutes for the cottons which at present have to be imported for the production of finer counts. The varieties used in the experiments were P.A. 289F, Cambodia Co. 1, Nandyal 14, and Surat 1027 A.L.F. The results of the tests are discussed at length, but in brief it was found that the process of combing even to the extent of 30 per cent. did not bring about a large increase in the mean fibre-length of any of the cottons; it was, however, remarkably effective in reducing fibre-length irregularity and neppiness, especially in P.A. 289 F. cotton. Although response to combing treatment was different for the different varieties, it was found that combing to the extent of 20 per cent. made a very considerable improvement in the spinning quality of each of the cottons tested, so that it was possible to spin 50's and 60's yarns from cottons which ordinarily are regarded as suitable for spinning up to a maximum of 30's warp.

7. SUPPLY AND DISTRIBUTION OF THE VARIOUS TYPES OF INDIAN COTTON, SEASON 1933-34. (*Stat. Bull., No. 4*, Ind. Cent. Cott. Comm., 1935.) We have received a copy of this pamphlet giving useful statistical and other information concerning—(a) Supply and distribution of the various types of Indian cotton during the season 1933-34; (b) the Indian cotton crop of 1933-34 season classified according to length of staple; (c) stocks of Indian raw cotton held in India by the mills and the trade on August 31, 1933 and 1934; (d) stocks of "Sailems," "Cambodias" and "Tinnevellics" held in the Madras Presidency by the mills and the trade on January 31, 1935; (e) receipts at mills in India of raw cotton, classified by varieties; (f) exports by sea of Indian raw cotton classified by varieties.

8. CORRELATION OF WEATHER CONDITIONS AND YIELD OF COTTON IN THE "NORTHERNS" AND "WESTERNS" TRACTS. By S. Ramakrishnan. (*Sankhya*, ii., 1, 1935, p. 43.) The method of trend-ratios based on five years moving averages was used in this paper, and it was found that there were significant correlations between certain items of weather data and the yield per acre of cotton in the two districts of Bellary and Kurnool in South India.

Using September rainfall and November maximum temperature it is possible to forecast in December the yield per acre of cotton in Bellary with a precision measured by a multiple correlation coefficient of 0.675. Including the rainfall in March and April (harvest period) as a third factor, the multiple correlation coefficient is increased to 0.766. For Kurnool with September rainfall and December temperature the coefficient (for 2 factors) was found to be 0.600. Including March and April rainfall the coefficient of multiple correlation (3 factors) for Kurnool was increased to 0.714. Large differences between forecast values and official estimates could in most cases be traced to abnormal factors regarding price or weather conditions other than those used in constructing the regression equations. The general conclusion is that weather conditions exert an appreciable influence on the yield per acre of cotton in Bellary and Kurnool, and that suitable forecasting formulæ can be obtained by correlational methods.

9. INDIAN COTTON YARNS: HUMIDITY-STRENGTH RELATIONSHIPS. By D. F. Kapadia. (*Indian Text J.*, **45**, 1935, p. 266. From *Summ. of Curr. Lit.*, xv., **15**, 1935, p. 392.) In determining the effect of humidity on the strength of yarns the author has sought to allow for the great influence of count irregularity by examining sufficient material and applying corrections. Four varieties of Indian cotton were spun to different counts and twist factors, and the yarns tested for count, single-thread breaking load and extension and ballistic work of rupture after conditioning at various humidities. The final analysis indicates that for these yarns a change of 1 per cent. R.H. results in a change of 0.303 per cent. of the breaking load and 0.641 per cent. of the extension, over the range 26.5-83.5 per cent. R.H., and a change of 0.384 per cent. in the ballistic work of rupture, over the range 64.89 per cent. R.H., the values at 70 per cent. R.H. being taken as the standard. There are indications, however, that the relationships are influenced by the variety of cotton and by the count and twist.

10. MYSORE: COTTON INVESTIGATIONS, 1933-34. (*Rpt. of Dpt. of Agr., Mysore*, 1934, recently received.) Trials were carried out by the Botanical Section with 69 new selections with a view to evolving cottons that were wilt-resistant and also of high yield and quality. The strain H. 190 gave very encouraging results, and was highly commended by the Bangalore Spinning and Weaving Mills. Research on Nadam American crosses and a number of Indian crosses was continued, and some 360 new crosses were made.

11. PUNJAB. Cotton Cultivation, 1934. (*Rpt. of Operations of Dpt. of Agr.*, 1934.) The total area under cotton in British districts of the Punjab was 2,449,402 acres, of which 809,123 acres were under American and 1,640,279 acres under Desi cottons. This showed an increase of about 30 per cent. over the previous year, due mainly to favourable climatic conditions at planting time, and to a decrease in the area under sugar cane.

Varietal, manurial, time of planting, spacing, hybridization experiments, and studies in the metabolism of the cotton plant were continued. Five new strains of American and one of Desi cottons were isolated. N.T. 36-F Early strain maintained its reputation for high yield and fibre quality, and continued to spread rapidly.

With the assistance of the Indian Central Cotton Committee a special mycologist has been employed for a period of three years to investigate root rot disease, which is the cause of serious injury to cotton in most areas of the province. Research work on white fly and bollworms was continued throughout the year.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

12. The following reports have recently been received:

ROTHAMSTED EXPERIMENTAL STATION: Ann. Rpt. for 1934.

BRITISH GUIANA: Admin. Rpt. of Dir. of Agr., 1934.

CYPRUS: Ann. Rpt. of Dpt. of Agr., 1934.

GAMBIA: Rpt. of Dpt. of Agr., 1934-35.

NYASALAND: Ann. Rpt. of Geol. Survey Dpt., 1934.

NORTHERN RHODESIA: Ann. Rpt. of Dpt. of Agr., 1934.

SUDAN: Ann. Rpt. of Dpt. of Agr., 1934.

TANGANYIKA: Ann. Rept. of Dpt. of Agr., 1934.

UGANDA: Ann. Rpt. of Dpt. of Agr., 1934. Pt. 1.

WEST INDIES: *Barbados*, Agr. J. of Dpt. of Sci. and Agr., iv., **2**, 1935.

„ *Montserrat*, Rpt. of Agr. Dpt., 1934.

„ *St. Lucia*, Ann. Rpt. of Agr. Dpt., 1934.

„ *St. Kitts-Nevis*, Rpt. of Agr. Dpt., 1934.

13. THE PROGRESS AND DEVELOPMENT OF COTTON GROWING WITHIN THE BRITISH EMPIRE. By Sir William Himbury. (*Cotton M/c*, 12/10/35.) An interesting review. A table is included giving areas, population, suitability of soils, production for 1934, and quality, for the principal cotton-growing countries of the Empire, followed by a brief outline of the progress made during the year. It is gratifying to note that production of Empire cotton for 1934 surpassed all previous records. A particularly attractive feature is the high standard of grading and ginning, so that prospective buyers can place implicit reliance on the contents of any bale as marked.

14. THE FUTURE OF TROPICAL AGRICULTURE. By H. Martin Leake. (*West Ind. Comm. Circ.*, 1., 965, 1935, p. 387.) The author writes that "development has been so rapid that area no longer offers any limitation to production. Vast potential areas, now lying undeveloped, are readily accessible, and merely await the prospect of a financial return which will attract the capital, to render them productive. Tropical agriculture is following—has, perhaps already followed—the steps of industry. An age of scarcity is giving place to an age of abundance; and an economy suited to the first is ill suited to the second. Further, to a larger extent than in industry, the market is limited, for a greater proportion of the products of tropical agriculture are food products. Purchasing power, as soon as it is restored, will not, therefore, stimulate the same expansion of demand; the saturation point will be sooner reached." A discussion of the situation follows with suggestions as to a way out.

15. ASIA. CYPRUS: Cotton Cultivation, 1934. (*Ann. Rpt. of Dpt. of Agr.*, 1934.) With the improvement in available irrigation supplies, and the more favourable early spring rains, there was an increase in area planted under irrigated and non-irrigated cotton, with a corresponding increase in production and exports. Although production was not up to the normal average, there was a considerable improvement over the two previous drought years.

16. Cotton Cultivation. (*Crown Colonist*, August, 1935, p. 395.) The Department of Agriculture has decided to encourage cotton cultivation in the island, and better varieties are to be introduced. In good years the export of cotton reaches some £50,000 in value. The island has one mill producing cotton yarn. Weaving is carried on by villagers in their own homes.

17. AFRICA. GAMBIA: Cotton Industry, 1934-35. (*Rpt. of Dpt. of Agr.*, *Gambia* 1934-35.) Cambodia and four selections of native cotton were grown for observation and further selection. Cambodia was generally superior to the native cottons in quality of lint and in jassid resistance. The cotton suffered from the following pests: American bollworm, Egyptian bollworm, and jassid. Several new ploughs were tried out during the year, the most satisfactory results being obtained with the Suttlej plough manufactured by Ransomes, Sims and Jefferies.

18. NIGERIA: Developing Native Agriculture. (*Crown Colonist*, October, 1935, p. 471.) The advice and assistance rendered by officers of the Agricultural Department to Nigerian peasant farmers have resulted in a marked improvement in the quality and yield of the major crops of the country, and an increased export of palm oil, cocoa, groundnuts, cotton, sesame, and ginger. In the Northern Provinces increased yields of all crops have been obtained through the introduction of ploughing with cattle and the making of farmyard manure. Three farmers were instructed in ploughing in 1928, and by 1934 the number had grown to 286. Farmers receive advances of about £5 per head from their Native Administration to cover cost of bullocks and implements. The advances are repayable with interest over a short period of years.

19. NYASALAND: *Cotton Prospects, 1934-35.* A report recently received from H.M. Eastern African Dependencies Trade and Information Office states that "there has been a tailing-off at certain markets in the Lower River. Early in September the crop showed some signs of going off in a number of the southern areas, and this can only be attributed to the cold spells experienced during July and August. Prices have maintained a satisfactorily steady level during the month. The season's Crown-land production on the northern extension north of Bilila is estimated to amount to 1,800 tons of seed cotton, while the districts of Blantyre, Central Shire, Zomba, Chiradsulu, Mlanje, Upper Shire, South Nyasa, and southern Ncheu have produced to date over 1300 tons."

20. NORTHERN RHODESIA: *Cotton Investigations.* (*Ann. Rpt. of Dpt. of Agr., 1934.*) Five years of work on cotton in the Acacia savannah, carried out by Messrs. Bebbington and Allan, showed conclusively that although soil and climate were quite suitable, the bollworm-stainer complex rendered cotton cultivation a hazardous venture. A detailed study of the stainer and its wild host plants was made, and it was found that a complete food sequence for stainers existed in this type of country largely owing to the prevalence of a perennial host, *Thespesia rogersii*. This led to the thought that cotton might conceivably do well if it were grown in areas in which *Thespesia rogersii* was rare or absent, and in this matter the Ecological Survey rendered valuable assistance. It was finally decided to investigate the possibilities of the Karroo sand region of the Namwala district. Five plots, scattered over a range of 40 miles and situated at varying distances from known host plants, were established in this region in December, 1933. They were successful beyond all expectation. Yields of the order of 700 lb. of seed cotton per acre were obtained, and insect damage was negligible. To obtain such yields from this type of soil in a year of unparalleled insect infestation, when yields at the Mazabuka Station were less than 20 lb. per acre, was a remarkable achievement.

Further trials in other promising zones are in progress, and if the results are successful, a cautious start in the development of the cotton industry in a selected area will be made.

21. SOUTHERN RHODESIA: *Notes from the Cotton Station, Gatooma, 1935.* By J. E. Peat. (*Rhod. Agr. J.*, xxxii., 10, 1935, p. 702.) Measures of control for American and Sudan bollworms and cotton stainers are discussed, and brief notes are included for the benefit of cultivators with little experience of cotton, dealing with the following: seed, time of planting, seed rate, depth of planting, spacing and thinning, early cultivations, soils, fertilizers, and picking.

22. SOUTH AFRICA: *Cotton Exports, 1934.* (*Crops and Markets*, July, 1935.) Approximately 1,075 bales of South African cotton were exported to the United Kingdom. The highest and lowest prices obtained during the year were 8-51d. best grade and 4-98d. lowest grade, being respectively about 180 points on and about 50 off American futures. Spinners using the cotton appeared quite satisfied with its spinning qualities.

23. *The Cotton Experiment Station at Barberton.* By F. R. Parnell. (*Farmg. in S. Afr.*, x., 112, 1935, p. 279.) A paper prepared at the request of the Division of Plant Industry with the object of making known to farmers the experimental work with cotton that is being done at Barberton. The station occupies 512 acres, of which about 160 are actually under crop. Cotton breeding, the most important branch of the work, is described, with the production of U.4. Fertilizer and cultivation experiments, work on rotation of crops and on insect pest control, are also discussed. An interesting and authoritative account.

24. Cotton Farming along the Orange River. By D. E. A. Gutsche. (*Farmg. in S. Afr.*, x., 114, 1935, p. 375.) The Orange River area is eminently suited to cotton growing, and in 1929-30 a record crop of 9,400 bales was obtained from 1,300 morgen. Rapid decline in prices of recent years, however, caused the industry to be neglected, but with the advent of better prices farmers may once again increase their acreage under this crop. The best variety to grow is still Improved Bancroft, and instruction is given on such matters as the selection and cultivation of the soil, time of planting, distance of spacing, irrigation of the crop, and the need for careful harvesting. The Orange River valley is remarkably free from insect pests and diseases which attack cotton, but occasionally a certain amount of damage is caused by stainers, wilt, and leafspot disease.

25. SUDAN: Rainfall and Cotton Yields in the Sudan Gezira. By E. M. Crowther and F. Crowther. (Reprinted from *Proc. of Roy. Soc. of Lond.*, Ser. B., cxviii., No. 809, p. 343, 1935.) The relationships between seasonal yield and weather fluctuations for cotton grown under irrigation in the Sudan Gezira were analyzed for periods up to twenty-three years. The analysis confirmed the generally recognized bad effects of high rainfall about the period of sowing cotton, but showed that this effect was not universal. An unsuspected but apparently general effect was discovered. Cotton yields were negatively correlated with the amount of early—May and June—rainfall. In some areas yields were negatively correlated with late rainfall and with the total rainfall in the preceding year. The differences between areas in their responses to weather could be partially interpreted in terms of their situations and agricultural histories.

The progressive decline in yield at the oldest trial farm could be largely accounted for by a significant increase in total rainfall during the period of cotton cultivation. The total annual rainfall in the Sudan Gezira exhibited a significant seven-year periodicity, which was reflected in cotton yields, dura exports, and recorded famines. It happened that the first trial of irrigated cotton and the first use of the Sennar Dam coincided with minimal rainfalls on this periodicity. The early promise and rapidly increasing difficulties may well have been due in part to the occurrence of unfavourable weather conditions and not necessarily to soil deterioration and pests.

Uniformly treated record areas could easily be established on a normal commercial basis in irrigation projects under central control, and would provide valuable material for research in agricultural meteorology, and a surer background for determining both experimental and commercial programmes.

26. TANGANYIKA: Cotton Cultivation, 1934. (*Ann. Rpt. of Dpt. of Agr.*, 1934.) A gratifying increase in the total cotton crop is recorded for the season. The highest yields were obtained in the Lake Province, the crop of the Eastern and Lindi Provinces falling short of expectations. Estate production showed a further increase, but still not one commensurate with both the very greatly extended areas planted by non-natives and the opportunities the crop provided.

Exports of cotton totalled some 31,612 bales, compared with 28,240 bales in 1933; this constituted a record for the territory.

During the period under review the valuable financial assistance rendered by the Empire Cotton Growing Corporation enabled the Department of Agriculture to establish two cotton variety multiplication farms, and also to reopen the Cotton Experiment Station at Mpanganya, and increase the staff and equipment of the stations at Ukiriguru, Lubaga, and Morogoro. Selection work was continued with U.4 and local cottons with a view to evolving strains suitable for the several districts. Some very promising isolations were made at Morogoro. At the Ukiriguru and Lubaga stations progress was made with the scheme to train natives to become peasant farmers.

No new ginneries were licensed in 1934. The British Cotton Growing Association very generously consented to provide two ginneries inspectors to serve in the territory for a period of five years.

Cotton pests of the chewing type, with the exception of locusts, were much less in evidence during the year than ever before recorded, but prolongation of the rains in many cotton districts produced conditions favourable to jassid, aphids, and several plant bugs.

Some progress was made in the control of soil erosion, a problem which has engaged the attention of the Department for the past five years.

27. UGANDA: Cotton Cultivation, 1934-35. (*Ann. Rpt. of Dpt. of Agr., 1934. Pt. I. recently received.*) The total area planted to cotton was 1,185,599 acres. Unfavourable growing conditions seriously affected the crop in the drier and lighter soil areas of the Eastern Province, where damage by blackarm and sucking insects was severe. Owing to the serious spread of pink bollworm, an additional entomologist was appointed by Government for a period of five years to carry out research on this pest. The number of ginneries licensed to gin and bale cotton was 137, as against 134 in the previous year. The establishment of cotton zones resulted in a more orderly marketing of the cotton crop, an elimination of much unnecessary motor transport, a great improvement in the grade of seed cotton purchased, and better facilities for the distribution of cotton seed of new strains. No appreciable damage from locusts or *Helopeltis* was recorded during the year, but injury from *Lygus* was severe and jassid also was present in larger numbers than usual. The number of ploughs in the possession of cultivators showed an increase of 2,120 over the previous year, but more instruction in their use is needed in some districts.

28. Cotton Industry, 1934-45. (*Crown Colonist, September, 1935, p. 426.*) 216,000 bales of cotton were exported during the first half of 1935, and cotton tax collected over the same period amounted to £65,000. Some 50,000 tons of cotton seed were marketed at prices ranging from Sh. 26 to Sh. 30 per ton.

29. Cotton Prospects, 1935-36. The latest report from the Dept. of Agriculture states that 1,366,974 acres were planted to cotton as compared with 1,185,599 acres in the previous season. A continued improvement in the condition of the crop took place during October, and prospects at the end of October were better than at the corresponding period last year.

30. Manurial Experiments. (*Bull. Imp. Inst., xxxiii. 2, 1935, p. 185.*) At the Serere Plantation the effect on subsequent cropping of a single application of manure is being tested in a 5 × 5 Latin square, the five treatments being: control; lime; farmyard manure at the rate of 10 tons, 20 tons, and 30 tons per acre. The manure was applied early in 1933 and the cropping since has been: 1933, green manure, followed by cotton; 1934, millet (*Eleusine coracana*), followed by cotton.

There were no significant differences in the yields of the first crop of cotton or in those of the millet, but there are indications that there will be a significant difference in favour of farmyard manure in the yield of the present crop of cotton.

31. AUSTRALASIA. QUEENSLAND: Cotton Cultivation. (*Int. Cott. Bull., xiii., 52, 1935, p. 565.*) Numerous varieties of cotton have been tested in Queensland, and Durango appears to give the best results as regards both yield and quality. It is expected that this type will soon be the standard cotton of Australia. The bulk of the Queensland crop falls within staple lengths of 1½ to 1¾ inches, usually running toward the longer length. The average grade of the Australian crop is said to be about equal to Good Middling American.

Studies made by the Queensland Department of Agriculture several years ago indicated that the cost of producing cotton in the State was in the neighbourhood of 3d. per lb. of seed cotton. This figure includes cost of ploughing, harrowing, planting, cultivating, thinning, picking, bagging, and cartage. The cost of picking is the most expensive item, the rate being around 1.5d. per lb. The cost of ginning also is high, being around 1.125d. per lb. of seed cotton.

32. Cotton Cultivation, 1934-35. (*Dalgety's Ann. Wool Rev.*, 1934-35, p. 133.) The area under cotton was approximately 60,000 acres. The early part of the season was favourable, but an intense dry period prevailed from February to the end of June. The production will not equal that of last year, but should, nevertheless, be the second highest yet recorded. For the first time the big-bolled medium-stapled, harder-bodied types of cotton have been produced in substantial quantities. Both Australian spinners and oversea buyers speak highly of the general quality of the crop.

33. FIJI: Spinning Tests on No. 172 Cotton. (*Crown Colonist*, September, 1935, p. 436.) Spinning tests on this cotton grown in Fiji in the 1933-34 season showed that the strength in 80's twist was 31 lb., which was 3.2 lb. stronger than the mill control type, and only 1 lb. weaker than the Sakel control in the previous year. This indicates that Fiji No. 172 should find a fair market comparable with F.G.F. Sakel. The chief drawback at present to the extension of cotton cultivation in Fiji is the difficulty of ensuring an adequate labour supply at rates which will leave a satisfactory return to the grower.

34. WEST INDIES. SEA ISLAND COTTON INDUSTRY. (*Trop. Agriculture*, xii., 10, 1935, p. 273.) During recent months much interest has been displayed in Sea Island cotton by several important firms in the United Kingdom, and in consequence much publicity has been given to Sea Island goods, especially shirts, underwear, and hosiery. These trade activities have been reflected in a continued improvement in the Sea Island cotton market. Old stocks have completely disappeared, and the bulk of the crop picked during the first half of the year has already been sold. Prices have mainly ranged between 1s. 3d. and 1s. 5d. per lb. of lint in the United Kingdom, but a small quantity has also been sold at 1s. 6d. per lb. A trade mark for marketing cotton goods manufactured from 100 per cent. Sea Island cotton has been registered on behalf of the West Indian Sea Island Cotton Association, and is now in operation.

35. SEA ISLAND COTTON. (*West Ind. Comm. Circ.*, l., 963, 1935, p. 350.) In their report of August 16, Messrs. Molyneux, Taylor and Co., of Liverpool, state that the coming season appears more favourable for the grower than for some considerable time. Stocks are to all intents and purposes non-existent. Prices continue firm, and for cotton of good character, staple and grade, a price of from 15½d. to 16½d. should be obtainable. A three months' agreement to prevent price cutting in the fine trade has been arranged, and many hope that this may be the forerunner of better trade. Another factor which has helped to raise prices is the generally improved quality of recent imports. The cotton from the various islands is not so mixed, is regular in grade, and staple does not show so much variation.

36. THE SEA ISLAND COTTON HARVEST IN THE BRITISH WEST INDIES. By Sir Algernon Aspinall. (*West Ind. Comm. Circ.*, l., 961, 1935, p. 311.) An interesting talk broadcast in June last, dealing with the history of Sea Island Cotton, the cotton-growing islands, the cultivation of the crop, and the goods that are to-day manufactured from Sea Island cotton.

37. BARBADOS: Cotton Cultivation, 1934-35. (*Agr. J. of Dpt. of Sci. and Agr., Barbados*, iv., 2, 1935.) Selected cotton seed was distributed for planting, but

owing to the drought which existed throughout the year, a poor stand was obtained, and the young seedlings died off after excellent germination had been secured. The Peasants' Cotton Plot Competition was held as usual in conjunction with the Peasants' Agricultural Exhibition, and the premier award again went to the prizewinner of the two previous years, who owed his success to the care with which he followed the instructions of the Department of Agriculture for planting cotton.

Pink bollworm caused little injury to cotton during the year.

To secure the introduction of only healthy material into the island, the holds of eighteen ships were fumigated with Zyklon B, and 9,843 bags of imported cotton seed were disinfected in the Simon's Heater.

38. MONTSERRAT. *Cotton Cultivation, 1934.* (*Rpt. of Agr. Dpt., Montserrat, 1934.*) Weather conditions were at first unfavourable, but they improved later, and a record crop was produced which averaged 283 lb. of lint per acre. Injury from pink bollworm was negligible, but cotton stainer was more in evidence than formerly. Prices paid for seed cotton opened at 2½d. per lb. and rose to 3d. plus cartage expenses. Large quantities of lint were sold locally at 10½d. per lb., for which there was keen competition. Prices obtained on the Liverpool market ranged from 1s. 1½d. to 1s. 2½d. To maintain the purity of Montserrat cotton a considerable number of breeding and propagation experiments are carried out annually by the Department, and satisfactory results have been obtained with the strain M6-14-10-21. During the year under review the Second Annual General Meeting of the West Indian Sea Island Cotton Association was held in the Island, and satisfaction was expressed by all representatives at the results achieved by the Association in placing the Sea Island cotton industry on a sounder basis.

39. ST. KITTS-NEVIS AND ANGUILLA. *Cotton Cultivation, 1934-35.* (*Ann. Rpt. of Dpt. of Agr., St. Kitts-Nevis, 1934.*) A slightly larger acreage was planted to cotton in St. Kitts in 1934, the production being 59,129 lb. of lint, of which 13.6 per cent. was stained cotton. Cotton selection work was carried out on the usual lines. About 1,000 acres were planted to cotton in Nevis. The seed germinated well, and the crop made good progress. Towards the end of the year cotton leafworm and pink bollworm caused much injury to the crop, and the cotton stainer also was unusually plentiful. Purchasing of the peasants' cotton was undertaken by the Government on the same lines as in previous years. An advance at the rate of 4 cents per lb. was paid on clean Sea Island cotton delivered at the cotton house. The lint was shipped to the British Cotton Growing Association, and was sold at a price which allowed a bonus of 2.6 cents per lb. to the peasants. The 1934-35 crop in Anguilla was estimated at 27,000 lb. lint. The quality of the cotton showed improvement, due to the use of hand-picked seed for planting. Injury from pink bollworm was not serious during the season.

40. ST. VINCENT: *Cotton Industry, 1934-35.* A note on the cotton crop for the quarter ended June 30 last, received from the Superintendent of Agriculture, is to the effect that "picking was completed by the end of April. Yields on the whole have been good, though the percentage of stained cotton, especially on the Windward coast, has been high. The total yield for the island was 173,735 lb. of lint, of which 146,091 lb. were white, and 27,644 lb.—approximately 16 per cent.—were stained. A number of growers fertilized their cotton with sulphate of ammonia, as manurial experiments indicated that cotton, under St. Vincent conditions, responds remarkably well to the addition of nitrogen to the soil. The addition of an excessive quantity of nitrogen, however, induced rank growth and excessive boll shedding on at least one estate. The cotton stainer was the only pest of any consequence, as pink bollworm did not appear till near

the end of the season, and then only in small numbers, doing little or no damage. Cotton stainers appeared on estates on the Windward coast in large numbers from the beginning of the year, though estates at the southern end of the island and on the Leeward coast were relatively free from this pest till near the end of the season. The Government cotton ginnery shipped 50 bales of cotton to England at the end of May, and these were immediately sold at ls. 4½d., a better price than last year's average. Market conditions have apparently improved and better and firmer prices are expected."

COTTON IN EGYPT.

41. STEPS TAKEN BY THE EGYPTIAN GOVERNMENT FOR THE BETTER MARKETING OF EGYPTIAN COTTON. By Hussein Bey Enan. (*Int. Cott. Bull.*, xiii., 52, 1935, p. 656.) Deals with (1) the prevention of mixing cotton varieties; (2) the elimination of foreign matter in cotton bales; (3) the intended legislation regarding cotton breeding in so far as new varieties are concerned.

42. ON THE RATIONALISATION OF THE GROWING AND MARKETING OF EGYPTIAN COTTON. By Youssef Bey Nahas. (*Int. Cott. Bull.*, xiii., 52, 1935, p. 655a.) The problem of over-production, the necessity for the reduction of all costs of production and distribution, and the working of the Egyptian Bank of Agricultural Credit, are discussed. The Bank provides credit to the cotton growers and thus renders the gradual marketing of the crop possible. Congestion at the market is avoided at the commencement of the season, and prices are maintained within normal limits. In addition facilities for storage at reduced rates are provided in the principal villages.

43. EGYPTIAN SEED CONTROL LAW: OPERATION. By W. L. Balls. (*Int. Cott. Bull.*, xiii., 1935, p. 642. From *Summ. of Curr. Lit.*, xv., 20, 1935, p. 520.) Graphs are given showing the operation of the Seed Control Law for Egyptian cotton during the eight years since its inception. The amount of Hindi seed has been taken as the index of contamination, although with the decreased amount now present in Egypt (as a result of the seed control) it has become less important for that purpose. But as Hindi, through natural selection, increases its proportion in a mixed population, it should afford a useful means for detecting samples too many generations distant from the parent stock.

44. PROGRESS REPORT OF THE SPINNING TEXT STATION AT GIZA. By H. A. Hancock. (*Int. Cott. Bull.*, xiii., 52, 1935, p. 664.) A description of the new station and of the special technique employed in carrying out the spinning tests.

COTTON IN THE UNITED STATES.

45. DEVELOPMENTS IN THE AMERICAN COTTON PROGRAMME. By A. G. Black, Chief, Bur. of Agr. Econ., U.S. Dept. of Agr., Washington, D.C. (*Cotton M/c*, 12/10/35). A careful account of the measures that have been adopted in the United States in connection with parity prices, marketing agreements and licenses, acreage reduction, the Bankhead Act, cotton loans, and universal standards for American cotton.

46. THE AMERICAN COTTON INDUSTRY. REPORT OF THE CABINET COMMITTEE ON PREVAILING CONDITIONS. By W. Whittam. (*Text. Rec.*, liii., 631, 1935, p. 20.) After examining every aspect of the Cotton Processing Tax the Committee found that prices of cotton goods appeared to be in approximate balance with the general level of costs, and that since the introduction of the tax the ratio of cotton consumption to the total consumption of the five leading textile fibres had not declined.

47. TEXTILES IN THE UNITED STATES. (*Test. Rec.*, liii., 630, 1935, p. 57.) The declaration of the Cotton Processing Tax as unconstitutional has resulted in scores of suits being entered by U.S. cotton users in order that their interests may be protected if the impost is eventually declared illegal.

Congress has passed an act which continues the Agricultural Adjustment Act. It also gives the Secretary of Agriculture greater powers to keep cotton prices on a parity with those of the products of the manufacturing industries, and at the same time continues the Bankhead Cotton Control Act for another crop year.

48. AMERICAN COTTON. A SERIOUS POSITION. (*Text. Rec.*, liii., 630, 1935, p. 17.) A rather pessimistic article, maintaining that "unless drastic changes are made in the growing and marketing of American cotton, the exports of raw cotton and cotton fabrics from the United States will practically cease within the next five years."

49. AMERICAN COTTON CROP: REDUCTION POLICY: DISADVANTAGES. By A. B. Cox. (*Cotton Trade J., Internat. Ed.*, 1934-35, p. 23. From *Summ. of Curr. Lit.*, xv., 15, 1935, p. 405.) It is shown that the decline in the gold value of the dollar accounts for the greater part of the increased dollar value of cotton, and that less than 1 cent of the advance in the price of cotton from 6.58 cents in New Orleans in January, 1932, to 12.56 cents in January, 1935, has been due to supply and demand conditions. This means that the reduction in cotton production has not effected any appreciable rise in cotton prices; the policy of restriction has increased unemployment and reduced the U.S.A. position in world markets.

50. AMERICAN COTTON PRODUCERS' POOL: GOVERNMENT EXPENDITURE. By O. Johnston. (*Cotton Trade J., Internat. Ed.*, 1934-35, p. 116. From *Summ. of Curr. Lit.*, xv., 15, 1935, p. 383.) The origin of the 1933 Cotton Producers' Pool, and its operation up to December 15, 1934, are discussed in detail. It has already cost the U.S. Government 60 million dollars, and to this will be added a further 19½ million dollars to certificate holders, and in addition holders of certificates representing 1,700,000 dollar bales will receive further advances if the price of cotton rises. This also will probably have to be met by Government.

51. AMERICAN COTTON: FOREIGN COMPETITION. By R. G. Tugwell. (*Cotton Trade J., Internat. Ed.*, 1934-35, p. 14. From *Summ. of Curr. Lit.*, xv., 15, 1935, p. 382.) The cotton acreage and production in countries other than the United States are discussed. Foreign production in 1933-34 was 22 per cent. greater than in the previous season, but foreign acreage was only 9 per cent. above 1932-33. In some countries where cotton expansion is occurring—e.g. Russia and China—the extra cotton is intended for home consumption, and in other countries, although the acreage may increase, the production, on account of climatic unsuitability, does not increase proportionately, or labour conditions and transport facilities may restrict the output. The author concludes that continuance of the present acreage restriction programme in U.S.A. for the next three years is unlikely to lead to an expansion in foreign production that will impede American dominance in world markets. During this season there has been, however, a drop in the proportion of American cotton, and a decline in the total quantity of cotton used in Europe, due partly to the increased use, on account of exchange difficulties in the import of cotton, of rayon substitutes for cotton in Italy and Germany.

52. THE PROBLEM OF CHARACTER STANDARDIZATION IN AMERICAN RAW COTTON. By C. M. Conrad and R. W. Webb. (*U.S. Dpt. of Agr., Bur. Agr. Econ., Div. of Cott. Marktg.*, Washington, D.C., 1935.) A preliminary report dealing with

(1) the need for character standards; (2) difficulties in the way of character standardization; (3) some probable character elements of quality, and (4) possible methods of attack on the character problem.

53. WORLD TEXTILES, WITH A REVIEW OF AMERICAN COTTON. (Pubd. by *Man. Guar. Coml.*, October 4, 1935.) Contains, among others, the following interesting articles: "American Cotton in 1934-35: Return to Freer Markets on the Way?" (G. W. Fooshe); "The Status of American Cotton" (C. T. Revere); "New Designs in Machinery" (F. Nasmith).

54. ALABAMA: Agronomic Research, 1933. By R. Y. Bailey *et al.* (*Alabama Sta. Rpt.*, 1933. From *Exp. Sta. Rec.*, 73, 1, 1935, p. 29.) Research work on cotton embraced the following: top-dressing experiments with potassium chloride on cotton; histological studies of the fibre and seed; vetch turned under at different dates for corn and cotton compared with parallel treatments of sodium nitrate; comparison of manure, sodium nitrate, and vetch, as nitrogen sources for cotton and corn in a two-year rotation.

55. ARIZONA: SXP Cotton Cultivation. By W. K. Shaw. (*Cotton Trade J., Internat Ed.*, 1934-35, p. 135. From *Summ. of Curr. Lit.*, xv., 15, 1935, p. 382.) SXP is an extra-staple variety developed from a cross between Egyptian Sakel and Arizona Pima through twelve generations of selection and inter-breeding. Its advantages are greater yield per acre, easier ginning, and tougher fibres.

56. FLORIDA: Sea Island Cotton. (*West Ind. Comm. Circ.*, 1, 963, 1935, p. 353.) Efforts to rehabilitate the Sea Island cotton industry in Florida would appear to be meeting with some success. A new method for weevil control is being tried out with satisfactory results, and a recent examination of the fields which were heavily infested during the first half of June showed no infestation where weevil control had been practised. Farmers are showing much interest in the demonstrations, and if good prices are received for the current crop, a much larger acreage will undoubtedly be planted in 1936.

57. LOUISIANA: Preliminary Studies of the Length and Uniformity of Staple of Louisiana Cotton Varieties. By H. B. Brown. (*La. Sta. Bull.*, 259, 1934. From *Exp. Sta. Rec.*, 72, 6, 1935, p. 763.) Arrays were made with the Suter-Webb cotton fibre sorter from hand-ginned and from machine-ginned samples from each of 20 leading cotton varieties grown in tests on alluvial land at Baton Rouge, and lint from the machine-ginned lots was also submitted to expert cotton classers for stapling. The variations in staple length and the percentages of each length group are shown graphically and discussed for each variety.

58. NORTH CAROLINA: Results of Cotton Variety Experiments, 1930-34. By P. H. Kime. (*N. Car. Sta. Agr. Inform. Circ.*, 92, 1935. From *Exp. Sta. Rec.*, 73, 1, 1935, p. 38.) Foster and Farm Relief cottons were recommended for heavy and poorly drained soils, and Dixie-Triumph, Clevevilt, and Dixie for wilt-infested soils.

59. OKLAHOMA: Current Farm Economics. (*Oklahoma Sta. Circ.*, Ser. 49, vol. viii., 3, June, 1935.) Cotton: The cotton produced in Oklahoma during 1934-35 averaged shorter in staple length than any crop produced in the State since 1929. Also, the average yield of lint per acre was below normal, especially in the western and south-western areas. This was due in great measure to the insufficient rainfall during the growing season.

60. Field Crops Experiments, 1932-34. By H. F. Murphy *et al.* (*Oklahoma Sta. [Bien.] Rpt.* 1933-34. From *Exp. Sta. Rec.*, 73, 1, 1935, p. 32.) Research work with cotton included varietal, breeding, and cultural tests. Studies were

made of factors affecting quality in cotton, including blooming, maturity, and shedding, and the effect of seasonal conditions on fruit formation; the effect of Texas root rot and cotton wilt on length, strength, and uniformity of fibre; and the effect of moisture on breaking strength of fibre.

61. SOUTH CAROLINA: *Field Crops Experiments*, 1934. By H. P. Cooper *et al.* (*S. Car. Sta. Rpt.*, 1934. From *Exp. Sta. Rec.*, 72, 6, 1935, p. 758.) Cotton research embraced the following: varietal tests; fertilizer studies with cotton, comprising placement, time and rate of applying sodium nitrate and potassium chloride for side-dressing, tests of brands of sodium nitrate, effects of additions of dolomitic limestone and calcium sulphate on yields of cotton in tests of sources of potassium and of phosphorus, a comparison of a cover crop of rye and vetch with fresh manure in cotton production, and effects of winter legume cover crops on cotton following, with and without sodium nitrate applications; seed treatments, and studies of fibre length and distribution in several varieties of cotton.

62. TEXAS: *Texas Cottons: Staple Characteristics*. By C. D. Brandt. (*Cotton Trade J., Internat. Ed.*, 1934-35, p. 33. From *Summ. of Curr. Lit.*, xv., 15, 1935, p. 392.) Staple diagrams are given for 32 types of cotton grown under the same conditions on a test plot in Texas. A table is presented showing values for the percentage lint, staple distribution and average length.

COTTON IN FOREIGN COUNTRIES.

63. BRAZILIAN COTTON: PRODUCTION. By J. E. Edmonds. (*Cotton Trade J., Internat. Ed.*, 1934-35, p. 24. From *Summ. of Curr. Lit.*, xv., 15, 1935, p. 382.) Within Brazil there is an area suitable for cotton production equal to the cotton belts of Texas and Oklahoma combined, and there is no labour shortage. At present Brazil is handicapped by lack of capital, transport difficulties, antiquated machinery, etc., but already she has increased her acreage and production very considerably, and is importing modern ginning machinery from U.S.A. The author considers that whether or not Brazil takes over in the future a considerable part of the foreign markets hitherto held by U.S.A. depends on the cotton policy adopted in the latter country. Its present policy of under-production is likely to direct some of the world's capital to financing the cotton industry in Brazil.

64. BRAZILIAN COTTON: EXPORT. By M. Biehl. (*Wirtschaftsdienst*, 20, 1935, p. 992. From *Summ. of Curr. Lit.*, xv., 16, 1935, p. 431.) The author discusses the economic changes in Brazilian trade due to the decline of coffee production and the rise of cotton. Statistics of imports and exports since 1930 are tabulated.

65. CHINESE COTTON PRODUCTION. By Volkart Brothers. (*Cotton Trade J., Internat. Ed.*, 1934-35, p. 36. From *Summ. of Curr. Lit.*, xv., 15, 1935, p. 382.) Details are tabulated of the cotton acreage and production imports, exports, and mill spindleage in China. Chinese cotton is mostly short and rough and is mainly used by Chinese-owned mills, the Japanese and British mills employing American, Egyptian, and long staple Chinese cotton.

66. COTTON CULTIVATION IN CHINA. By M. Biehl. (*Wirtschaftsdienst*, 20, 1935, p. 961. From *Summ. of Curr. Lit.*, xv., 15, 1935, p. 382.) The possibilities of extending cotton growing in China are reviewed, especially in relation to the competition with food crops and to Japanese influences. China produced 3 million bales (500 lb.) in 1934. It is thought that by adjusting the demands of food crops it might be possible to harvest three crops of cotton in two years, and thus add 2½-3 million more bales to China's yearly output.

67. ASSOCIATION COTONNIÈRE COLONIALE. *Bull. No. 19, 1935*, contains the following papers: "Quelques notes sur le coton Egyptien" (G. Allemann); "De la production cotonnière mondiale dans ses rapports avec les moyens de la réaliser" (G. Carle).

Bull. No. 20 contains the following articles: "La culture du coton en Syrie en 1934" (M. Pignarre). The country is considered well suited to cotton. "La reprise de la culture du coton en Algérie sur des données nouvelles" (P. Hanhart). "Le ver rose du cotonnier à la Guadeloupe" (H. Stehle). "L'industrie cotonnière française et le marché colonial" (M. R. de la Baumelle).

The usual notes on cotton in the French Colonies and other cotton-growing countries, cotton legislation, marketing, etc., are included in the bulletins.

68. GERMANY: RAW COTTON IMPORTS. (*Spinn. u. Web.*, 53, 25, 1935, p. 16. From *Summ. of Curr. Lit.*, xv., 14, 1935, p. 358.) German imports of cotton from the United States have fallen considerably in recent years, and in the first four months of this year about one-quarter of the total imports of raw cotton came from Brazil. New trading regulations and the growth of the Brazilian cotton industry, however, will cause a large reduction in imports from Brazil in the near future. Imports of raw cotton from Egypt and India have so far been lower this year than last year, but increased trade with these countries should be possible. Substitutes for Brazilian cotton may be found in other South and Central American countries, Africa and Turkey. Appreciable quantities of cotton have already been imported from the Argentine, Peru, and South Africa. Further possible sources include Russia, Persia, and China.

69. ITALIAN COTTON IMPORTS: ADVANTAGES OF NET WEIGHT TRADING. By M. Volpi. (*Cotton Trade J., Internat. Ed.*, 1934-35, p. 93. From *Summ. of Curr. Lit.*, xv., 15, 1935, p. 383.) In 1932 Italian spinners enforced the adoption of a contract regulating imports of American cotton on the net weight basis. The advantages of, and monetary saving effected by, net weight trading are fully discussed.

70. JAPANESE COTTON INDUSTRY: EXPANSION. (*Cotton Trade J., Internat. Ed.*, 1934-35, p. 98. From *Summ. of Curr. Lit.*, xv., 15, 1935, p. 405.) The expansion of Japan's cotton industry is due primarily to low costs of production, and the devaluation of the yen, but contributory causes are her mechanical efficiency and expertness in buying and marketing.

71. PERUVIAN COTTON: EXPORT. By K. Martens. (*Wirtschaftsdienst*, 20, 1935, p. 995. From *Summ. of Curr. Lit.*, xv., 16, 1935, p. 431.) The economic condition of Peru is reviewed, and statistics are quoted. Increased export of cotton in recent months has compensated for losses in the sugar and hide markets. The young Peruvian industry is confined to ten large concerns, financed mainly by British, American, and Italian money, and working about 4,500 looms.

72. PERU: Memoria de la Junta Directiva de la Sociedad Nacional Agraria, 1932-34. (Publ. Lima, 1935.) Includes a notice of the death of Don Fermin Tanguis, who discovered the variety known as Tanguis cotton, and legislation in connection with the import and export of cotton and cotton seed.

73. EL ALGODON TANGUIS Y SU ORIGEN. By R. A. Ferrero. (*Soc. Nac. Agraria*, Lima, Peru, 1935.) Three hypotheses exist as to the origin of Tanguis: (1) that it is a mutation from Suave; (2) that it is a hybrid between Semi-aspero and Suave; (3) that in this hybridization there took part a mutation of Suave which was immune to wilt. The author considers the second to be correct, and to be the origin of the ancestors of the plant selected by Dr. Tanguis. In support of this he gives a comparative organographical study of Tanguis, Suave, and Semi-aspero, and an analysis of the facts, together with biometrical measurements and the

results of actual crossing of the two latter forms. He then discusses the criticisms of this hypothesis advanced by the supporters of (1), recently published in an official bulletin by Barducci, and (3), and concludes that there is not enough evidence to justify their acceptance as against (2). (*Cf. Abstr. 628*, vol. xii. of this Review.)

74. RUSSIA. We have received from Tashkent copies of the publication *Bobrza za Khlopok*, Nos. 6-12, 1934, and 1-6, 1935, containing various papers in Russian dealing with different aspects of cotton cultivation. The following are the titles in English of some of the articles: "Improved Organization of Mechanized Harvesting of Cotton" (D. S. Davidovich); "For a High Quality of Cotton Fibre" (A. P. Kliukhin); "Autumn Application of Mineral Fertilizers to Cotton" (D. H. Kharkov); "Complete Pollination Increases the Yield by 15-40 per Cent." (V. V. Starov); "Let us Include Bees in the Drive for a High Cotton Yield" (V. E. Riazanov); "Behaviour of Cotton Varieties under Irrigation" (Z. E. Pudovkina); "Yarovization of Cotton in the Fields of the New Cotton Regions" (E. A. Ivanishin); "Light Traps as Control Measures for Cotton Field Pests" (P. P. Bogush); "A New Cotton Hybrid" (A. Maltzev); "For a Complete and Effective Utilization of Mineral Fertilizers in 1935" (A. K. Anastasov); "Mechanization of Fertilizer Distribution for Cotton" (P. V. Kazhikhin); "Cotton Flea Damage in Turkmenia in 1934" (P. P. Bogush); "The First Results of the Introduction of New Cotton Varieties" (A. M. Maltzev); "Seed Drill 'SSG'" (F. A. Koshevnikov); "Vernalization Experiment with Cotton in the 'Kolkhoses' of the Stalin Region" (A. A. Kalanin); "Density of Stand in Cotton" (A. Dudko); "Variety '114' Mubariz" (E. Varuntsian); "Cotton Wilt" (L. Rumshevich); "Some Problems of Tractor Cultivation" (V. E. Konkov); "Control of Pests" (V. Y. Novitsky).

SOILS AND MANURES.

75. ROTHAMSTED EXPERIMENTAL STATION. In the Report for 1934 it is stated that the outstanding event of the year was the purchase of the farm and a further part of the estate by the Rothamsted Trustees. The estate included the manor house, the farm manager's house, and eight cottages, and the total area of land acquired was 527 acres. The purchase amount of £35,000 was raised by public subscription. Further developments are planned, which it is anticipated will cost some £25,000.

The work of the year in connection with crop production, organic manures, grassland investigations, plant pathology, entomology, insecticides, physical and chemical properties of the soil, etc., is discussed. During the period under review 101 papers were published in various scientific journals, and summaries of 54 of these are included in the report.

76. DANGERS OF DETERIORATION UNDER CONTINUOUS CROPPING. By H. H. Mann. (*Rothamsted Confs. No. 17*, 1934, p. 30. From *Exp. Sta. Rec.*, 72, 3, 1935, p. 301.) In presenting and discussing field plot data, recorded from 1877 to 1926, to show the steady decline in yields from continuously cropped land, the author admits that "at present the explanation evades us," but issues "a warning against the idea that by the use of artificial manures or any other means the falling off in value of continuously grown crops can be avoided. It is often . . . a great temptation to grow a valuable crop very frequently, if not continuously, and trust to heavy artificial manuring to maintain the fertility of the land. This policy is definitely dangerous, and, if long continued, all the evidence available would indicate that the land will deteriorate in value."

77. SOME ASPECTS OF THE BLACK COTTON SOILS OF CENTRAL PROVINCES, INDIA. By D. V. Bal. (*Emp. J. of Exp. Agr.*, iii., 2, 1935, p. 261.) A brief account is given of the chemical and biochemical aspects of black cotton soils. The lime content of these soils generally varies inversely with the rainfall of the localities in which they are found. Appreciable amounts of calcium and silica are leached from the surface-soil, and a certain amount of clay is also washed down continually from the surface-soil. These soils contain a low percentage of nitrogen and organic matter. The rate of (a) biological oxidation of organic matter, and (b) formation of ammonia and nitrates from organic nitrogen, is very vigorous. In these heavy soils the biological activities are at their best when the moisture-content is about half the maximum water-holding capacity. Nitrification in artificially watered soils previously air-dried is slower in starting than with soils receiving natural rainfall, but the nitrifying efficiency after a period of eight weeks is about the same. A heavy clay soil that has lost its texture shows at first a diminished nitrifying power when compared with the same type of soil in good condition. The nitrifying organisms of the soil can tolerate a fairly high concentration of free ammonia, and form nitrates from it in the soil.

78. STUDIES IN TROPICAL SOILS. INCREASE OF ACIDITY WITH DEPTH. By H. C. Doyne. (*J. Agr. Sci.*, xxv., 192, 1935. From *E. Afr. Agr. J.*, i., 2, 1935, p. 94.) The author records Nigerian soil profiles showing acidity increasing with depth, and refers briefly to the agricultural importance of this peculiar feature of many tropical soils. Two types of acidity profile are shown: one in which acidity increases abruptly in the immediate subsoil, and then shows regular increase or decrease; the other in which acidity increases gradually to the middle subsoil, and then decreases to the base of the profile.

79. EFFECT OF SUNLIGHT ON THE NITRIFICATION OF AMMONIUM SALTS IN SOILS. By G. S. Fraps and A. J. Sterges. (*Soil Sci.*, 39, 2, 1935, p. 85. From *Exp. Sta. Rec.*, 73, 1, 1935, p. 19.) The authors were unable to demonstrate in Texas soils the photochemical nitrification observed by Dhar and others in India, finding, on the contrary, that nitrification in sterilized soils occurred neither in the light nor in darkness except in the case of one soil, of which it is stated that it "was probably not completed sterilized."

It is further stated that "although this work does not entirely exclude the possibility of photonitrification, it shows not only that photonitrification must be of little or no practical importance, but also that sunlight greatly decreases the nitrification caused by bacterial action when the bacteria are directly exposed to the sunlight. Since only a small portion of the soil is exposed to direct sunlight, the destructive action of sunlight upon nitrifying organisms is not unlikely to be of agricultural importance."

80. MANURES AND MANURING. By A. P. Cliff. (*Agr. and Livestock in India*, v., 4, 1935, p. 334.) A useful article on the subject, dealing with the value of farmyard manure, compost, green manure, oil cakes, and artificial manures, to Indian soils, and the costs of the various manures.

81. SUPPRESSION OF WEEDS BY FERTILIZERS AND CHEMICALS. By H. C. Long, of the Min. of Agr. and Fisheries. (Obtainable from the author at "The Birkins," Orchard Road, Hook, Surbiton. Price 2s. net, postage 2d. extra.) A description and discussion of the various ways in which different chemical substances may be employed for the treatment of weeds, and of their efficacy. The booklet extends to 57 pages, together with 17 illustrations.

82. IRRIGATION AND MANURING OF COTTON. By P. V. Starov. (In Russian.) (*Borba za Khlopok*, 3-4, p. 41, Tashkent, 1935.) An investigation on the time for applications of fertilizers. The highest yields were obtained when fertilizers

were applied at the time of the formation of flower buds and at flowering time. Irrigating in deep as against shallow furrows caused a further increase in yield.

83. HOW TO APPLY MINERAL FERTILIZERS TO COTTON DURING THE VEGETATIVE PERIOD. By D. V. Kharkov. (In Russian.) (*Borba za Khlopok*, 5-6, p. 53, Tashkent, 1935.) The time of application depends on climate and soil, and also on irrigation conditions. The method of application depends on the cultivation methods, and whether the fertilizers are applied before or after irrigation. Banner's drill, or distribution of the fertilizers by hand, are the methods recommended. A new machine called the "Plantfeeder" is being perfected, which applies the fertilizers in solution to the crop.

84. AN EXPERIMENT ON THE APPLICATION OF AMMONIUM NITRATE TO COTTON IN SOLUTION FORM DURING THE VEGETATIVE PERIOD. By I. P. Malinkin. (In Russian.) (*Borba za Khlopok*, 5-6, p. 117, Tashkent, 1935.) Describes a new machine for applying ammonium nitrate to cotton in solution form. This so-called "plant feeder" consists of an iron tank on two wheels. A distribution chamber is situated under the tank, and is connected to it by a pipe; rubber tubes conduct the solution from the chamber to three coulters, the amount of solution applied being regulated by valves inside the coulters. This machine is being perfected.

85. COTTON PLANT: TESTING NITROGEN REQUIREMENT. By G. S. Dawtjan. (*Chim. ssozialist. Semledeliya*, No. 3, 1934, p. 68. From *Summ. of Curr. Lit.*, xv., 16, 1935, p. 421.) A method of testing whether corn stalks are deficient in nutrient supply was developed by Hoffer (1926), in which the cut ends were stained by suitable reagents. This is now modified for cotton. Nitrogen deficiency is tested by placing the stalks in a diphenylamine reagent and noting the colour after 20-30 seconds.

86. AN ANALYSIS OF THE FACTORS GOVERNING THE RESPONSE TO MANURING OF COTTON IN EGYPT. By D. S. Gracie and F. Khalil, in collaboration with H. Enan. (*Tech. and Sci. Serv. Bull.* No. 152, Min. of Agr. Egypt, 1935.) *Summary.*—Owing to the pink bollworm, cotton growing in Egypt is dominated by the necessity for an early crop; as early a rise and as high a maximum of the flowering curve as are possible are imperative, since there must always be much more than an element of uncertainty about the fate of the late-formed bolls. This feature of the situation is measured in the experiments by the figures for the proportion of the total yield obtained at the second picking—only where an increase in yield from an application of a factor is accompanied by an unchanged or reduced percentage at the second picking is that factor regarded as having been really limiting. The factors of sowing date, spacing and watering are limiting ones in this sense, since their proper adjustment is determined by the necessity for the early crop.

Mean deficiency in soil nitrogen is limiting in the experiments only to the extent of the half-kantar obtained in 1931 with one sack of nitrate, and without alteration in the proportion of the crop at the second picking. This figure includes the few exceptional experiments in which nitrogen deficiency was extreme.

Yield effects from nitrogen are thereafter entirely and positively correlated with (1) high level of yield, and (2) increased proportion of the crop at the second picking—i.e. on the ripening of the late-formed bolls. Whether these two correlations operate or not depends on the weather conditions in July and August. When these months are excessively hot, as in 1931, shedding was so excessive that there was no economic return after the first sack; when they are cool more bolls come to maturity. There are also definite indications that the greater amount of shedding in hot seasons is reinforced by a heavier pink bollworm

attack—i.e., by an actual larger number of attacked bolls per plant, the total number of bolls having already been reduced by shedding.

The level of yield which primarily conditions the amount of response possible, and so dominates the situation, is an expression of the degree of water strain to which the plants have been subjected. The amount of water available is directly related to the size of the root system, and the latter is in turn decided by the physical properties of the soil such as permeability to water and air, properties which are in the main a reflection of the amount of deterioration the soil has undergone. Large results from nitrogenous manuring can only be obtained on first-class land in suitable seasons.

The variety grown may cause subsidiary alterations in the level of yield through variations in the efficiency with which the available water is utilized.

Finally, it has been shown that, in contrast to cotton, nitrogen is the main factor limiting the yield of the shallower-rooted maize crop.

87. RATE OF FERTILIZING COTTON WITH AND WITHOUT POISONING. By R. Y. Bailey and J. M. Robinson. (*45th Ann. Rpt. Agr. Exp. Sta. Alabama*, 1934, p. 13.) Four different rates of a 4-8-9-6-4-8 fertilizer made from nitrate of soda, superphosphates, and muriate of potash were compared for cotton on Norfolk sandy loam at Auburn over the ten-year period 1924-33. Treatments were duplicated on two sections. Cotton on one section was dusted for the control of boll weevil when the average infestation had reached 10 per cent.; the cotton on the corresponding section was not dusted.

The rates of fertilizer application were varied by increments of 500 lb. per acre through 2,000 lb. Every third plot was left unfertilized as a check plot. Boll weevil infestation was heavy enough during six years of the ten to necessitate dusting. This dusting for boll weevil has accounted for an average increase of 40 lb. of seed cotton per acre on the check plots and 203 lb. on the fertilized plots. The increases in yield for the different fertilizer applications on the dusted section were 576, 454, 186, and 83 lb. of seed cotton per acre for the first, second, third, and fourth increment of 500 lb. respectively.

88. MANUFACTURE OF COMPOST BY THE "INDORE" SYSTEM. Experiments on the manufacture of compost by a modified form of the Indore process are being carried out in several countries. In Ceylon (*Bull. Imp. Inst.*, xxxii., 2, 1935, p. 183) 28 pits were employed in the making of compost in 1934. These pits are not roofed in, since it is considered that the total rainfall in a normal year is adequate for the supply of sufficient moisture to the compost heaps for their proper decomposition. The materials used include *Gliricidia* loppings, Canna tops, coffee suckers and prunings, cattle bedding, wild sunflower, cacao shells, and coffee pulpings. Some very satisfactory compost has been made which in texture has been all that could be desired.

At Serere, Uganda (*Bull. Imp. Inst.*, xxxiii., 2, 1935, p. 185), an experiment has been made with the grass *Imperata cylindrica*, of which there are large patches at the station, and which is of no value for grazing or as bedding for cattle. A ton of compost a day is manufactured, which complies with the standard of fineness laid down by Howard. A start has also been made at Bukalasa, utilizing all the waste products of the station, and the early results have been distinctly promising.

At Abercorn, Northern Rhodesia (*Ann. Rpt. Dpt. of Agr. N. Rhod.*, 1934, p. 11), the process has been adapted to local conditions, and is now part of the daily routine. Analyses showed the product to be deficient in nitrogen and phosphoric acid, and it may be necessary to revise the manufacturing methods.

89. SOIL BLOWING AND DUST STORMS. By C. E. Kellog. (*U.S. Dept. Agr., Misc. Pubn.* 221, 1935. From *Exp. Sta. Rec.*, 73, 2, 1935, p. 158.) The author

concludes that "during extremely dry years there always has been and always will be some soil blowing. With a selection of lands for various uses and the wider adoption of superior tillage methods, soil blowing can certainly be reduced, probably to a point such that it will not endanger the agriculture of the region." Windbreaks, or "shelter belts," consisting of close rows of trees planted in a line at right angles to the direction of the prevailing winds, are described as one of the means for lessening soil blowing, for which "there exists a considerable possibility of success," especially east of about the hundredth meridian.

90. THE DANGERS OF SOIL EROSION AND METHODS OF PREVENTION. (*Rhod. Agr. J.*, xxxii., 8, p. 533.) The evil effects of soil erosion in South Africa and Southern Rhodesia are discussed, and practical advice given on soil conservation work.

91. TERMITES IN RELATION TO VELD DESTRUCTION AND EROSION. By T. J. Naude. (*Bull. Dept. Agr. S. Afr.*, No. 134, 1934. From *Rev. App. Ent.*, xxiii., Ser. A., 7, 1935, p. 377.) Destruction of grasslands by termites is increasing in Southern Africa, and instructions are given on methods to combat the pest.

92. THE USE OF DITCHERS FOR CONSTRUCTING CONTOUR RIDGES. By C. Tapson. (*Rhod. Agr. J.*, xxxii., 9, 1935, p. 103.) The use of a ditcher is said to materially speed up the work of constructing contour ridges, and with a good team of 18 oxen, 800 yards of ridging with a base width of 12 feet and 2 feet in height should be completed in a day. The operations are described.

93. CIVILIZATION AND SOIL EROSION. By W. C. Lowdermilk. (*Rhod. Agr. J.*, xxxii., 8, 1935, p. 553.) Mainly concerned with soil erosion problems in the United States.

94. RESULTS OF ENGINEERING EXPERIMENTS AT THE SOIL EROSION STATIONS. By C. E. Ramser. (*Agr. Eng.*, 15, 11, 1934. From *Exp. Sta. Rec.*, 73, 1, 1935, p. 112.) This is a contribution from the U.S.D.A. Bureau of Agricultural Engineering, in which a summary is given of some of the more important experiments being conducted at the soil erosion experiment stations. These relate primarily to the proper spacing, grade, height, cross section, and limiting lengths of terraces for any particular soil or land slope. Information also is given relating to methods of constructing and maintaining terraces, and on the proper size, location, and control of terrace outlet ditches.

95. EROSION CONTROL INVESTIGATIONS BY THE TENNESSEE STATION. (*Tennessee Sta. Rpt.*, 1933. From *Exp. Sta. Rec.*, 73, 2, 1935, p. 250.) These studies emphasize (i.) the importance of terracing for the protection of land planted to row crops, and (ii.) the protective action of pasture grasses.

96. A NEW TYPE OF TERRACING MACHINE. By E. V. Collins *et al.* (*Agr. Engin.*, 16, 1, 1935. From *Exp. Sta. Rec.*, 73, 1, 1935, p. 113.) In a contribution from the Iowa Experiment Station a new type of terracing machine is briefly described which involves the principle of a high-speed pulverator. The machine consists essentially of a single-bottom tractor plough with shortened mouldboard, and a rotor driven by the power take-off into a transmission providing either a direct drive or an overdrive of 1.8 to 1.

CULTIVATION, IRRIGATION, GINNING, ETC.

97. THE DESIGN OF EXPERIMENTS. By R. A. Fisher. (Pubd. by Oliver and Boyd, Ltd., Edinburgh, 1935. Price 12s. 6d. net.) The design of experiments is too large a subject, and of too great importance to the general body of scientific workers, for any incidental treatment to be adequate. A clear grasp of simple and standardized statistical procedures will go far to elucidate the principles

of experimentation; but these procedures are themselves only the means to a more important end. Their part is to satisfy the requirements of sound and intelligible experimental design, and to supply the machinery for unambiguous interpretation. To attain a clear grasp of these requirements it is necessary to study designs which have been widely successful in many fields, and to examine their structure in relation to the requirements of valid inference.

The examples chosen in this book are aimed at illustrating the principles of successful experimentation; first, in their simplest possible applications, and later, in regard to the more elaborate structures by which the different advantages sought may be combined. Statistical discussion has been reduced to a minimum and all the processes required will be found more fully exemplified in the author's previous work, "Statistical Methods for Research Workers."

The various sections of the book are headed: I. Introduction; II. The Principles of Experimentation, illustrated by a Psycho-Physical Experiment; III. A Historical Experiment on Growth Rate; IV. An Agricultural Experiment in Randomized Blocks; V. The Latin Square; VI. The Factorial Design of Experimentation; VII. Confounding; VIII. Special Cases of Partial Confounding; IX. The Increase of Precision by Concomitant Measurements. Statistical Control; X. The Generalization of Null Hypotheses. Fiducial Probability; XI. The Measurement of Amount of Information in General. An Index is included.

98. THE PRINCIPLES AND PRACTICE OF FIELD EXPERIMENTATION. By J. Wishart and H. G. Sanders. (Pubd. by the Empire Cotton Growing Corporation. 1935. Price 3s., post free.) "The Principles and Practice of Yield Trials," by Engledew and Yule, was first published in 1926. Since then an entirely new technique of plot arrangement and analysis of results by statistical methods has been introduced by Fisher. The new work is a detailed manual for experimentalists in which these methods are described and illustrated, and many of the practical considerations to be taken into account are discussed. The first part, "Principles," opens with an account of the difficulties due to soil heterogeneity and other sources of error. A section follows on the elementary statistical methods used, which are stated and explained without mathematical proofs. Tables are provided of probabilities associated with the normal curve, the "Student" *t*-distribution and Fisher's *z*-criterion. The objects of an experiment, and a simple suggested method, are then discussed, an opportunity being provided here to describe and illustrate by example the analysis of variance technique of Fisher. There follow sections on the methods of Randomized Blocks and the Latin square, which provide for a reduction of experimental error by means of local control. Examples from actual trials are provided, and the arithmetical processes described in detail. A further section deals with the ways in which the variation due to treatment can sometimes be analyzed, and with multiple factor experiments, an illustration being supplied of the split-plot type of design. This part is concluded by a fairly extensive section on the analysis of covariance method of taking into account the correlated variation in an observation allied to the one on which information is desired, the object being to secure an increase in precision. An example from a field trial is worked through by stages in order to illustrate the method.

The second part is entitled "Practical Considerations." It opens with a section dealing with general procedure. Broad questions of policy, the questions an experiment is expected to answer, and the care to be taken in selecting sites for experimental purposes, are among the topics discussed. The agricultural significance of experimental results is then dealt with. The limitations, due to site and season, of a single trial are commented on, and guidance given concerning

repetition. Other factors besides yield which contribute to remunerativeness are mentioned, and the difficulty of assessing quality in the case of the common crops is discussed. Observation plots are considered important, and have a section to themselves; in a further section existing knowledge on size, shape and arrangement of plots is summarized. The choice generally lies between Randomized Blocks and the Latin square, and the considerations guiding an experimenter in his choice are stated. Suggested arrangements are put forward, and a case made out for experiments in which two or more sets of treatments are incorporated in all combinations. Observations to be taken on plots form the subject of the next section. Following on this there is a discussion of methods of sampling, preceded in the first part by a short statement of the underlying theory, and followed by experimental illustration. In a final section a number of points of detail are considered.

99. QUEENSLAND: Cotton Rotations. By W. G. Wells. (*Queensland Agr. J.*, xliv., 2, 1935, p. 182.) Investigations carried out in recent seasons indicated that certain chemical and physical changes were occurring in the soils with the continuous cultivation of cotton on the same land, that made it imperative that this practice be stopped and some form of crop rotation adopted. A series of rotations in which Rhodes grass, Sudan grass, giant panicum, sachaline, sorghum, and maize are grown alternately with cotton, and also longer ones, such as wheat-maize-cotton, oats-maize-cotton, etc., are being carried out at the Cotton Research Station. The greatest success up to the present has been obtained with Rhodes grass. The crops following Rhodes grass outyielded cotton following cotton plots by 124 lb. seed cotton per acre on flat very fertile alluvial clay loams, and by 80 lb. per acre on a slight sandy clay slope with low moisture-holding capacity.

100. IRRIGATION OF COTTON DURING RIPENING. By P. V. Starov. (In Russian.) (*Borba za Khlopok*, 6-7, p. 33, Tashkent, 1934.) Dates for final irrigations are given for different types of soils under local conditions. Three types of soil mentioned: easily drained soils, clay soils with a low water table, clay soils with a high water table.

101. FURTHER EXPERIMENTS ON THE INTERRELATION OF FACTORS CONTROLLING THE PRODUCTION OF COTTON UNDER IRRIGATION IN THE SUDAN. By A. R. Lambert and F. Crowther. (*Emp. J. of Exp. Agr.*, iii., Nos. 11 and 12, 1935, pp. 276 and 289.) Field experiments are described which were designed to test whether conclusions drawn from experiments made on the Gezira Research Farm are applicable over the large areas of cultivation included under the Gezira Irrigation Scheme. Four experiments were undertaken in 1932-33, and five in 1933-34. In each experiment comparisons were made of sowing-dates, spacings, and nitrogenous manuring in different combinations. The marked superiority of closer spacing of the plants with sowings made after the optimum date, was established in all experiments, and this confirmed the conclusions from the earlier experiments. There was also seasonal variation in the extent to which wide spacings, with earlier sown cotton, were able to compensate for the fewer plants per unit area. The variation in response to manuring with sowing-date was not clearly defined owing, apparently, to interference by disease damage. Where disease damage was light the greater response to manuring with earlier sowing, established at the Research Farm, was once more obtained. An additional experiment, designed to augment the available information on different numbers of plants per hole and different dates of thinning, is also discussed. The experiment comprised 240 plots and, in addition to showing that good yields could be

obtained with late sowings if less drastic thinning were employed, demonstrated the varying importance of date of thinning as a factor controlling yield.

[Cf. Abstr. 72, Vol. X. of this Review.]

102. GINNING COTTON. By C. A. Bennett and F. L. Gerdes. (*U.S. Dpt. of Agr. Farmers' Bull. No. 1748*, Washington, D.C., 1935.) Cotton farmers benefit from good ginning, and can promote this by furnishing their cotton in good ginning condition, while at the same time demanding that the ginner employ the methods that best preserve lint quality.

Excessive moisture markedly reduces the quality of the lint, and the cotton should be sun-dried before going to the gin. Economical drying at the gin is desirable, and vertical driers have been designed. In the one most generally used the damp seed cotton is introduced into a continuous stream of hot air which carries it to the top of the tower, whence it descends in a zigzag way, striking against the warm walls, and finally striking against the screen at the base of the tower. The process results in marked cleaning of the cotton. Operating costs are from 30-50 cents a bale. Illustrations are included of the machines and also showing the great improvements effected in the grade of the cotton.

Cotton houses for storing seed cotton, with suction fans for conveying it to the gin, are a feature of many American ginneries. Cleaners and extractors are also in use to handle the very inferior grades resulting from the action of storms, etc., upon the cotton. Different types suit different conditions, and it is important that farmers as well as ginneries should understand which is the best type for local conditions.

The paper then goes on to consider feeders, and it is emphasized that the farmer stands to lose considerably if he insists upon too rapid feed—"crowding his cotton through the gins." Pressing and baling are then dealt with, and the paper ends with a note on the care, maintenance and operation of gins. The whole forms a treatise which should be in the hands of everyone concerned with ginning.

103. COTTON GINNING: DEVELOPMENT. By V. C. Marshall. (*Cotton Trade J., Internat. Ed.*, 1934-35, p. 27. From *Summ. of Curr. Lit.*, xv., 15, 1935, p. 382.) The development is outlined of cotton ginning, from the time before the Civil War, when it was done by crude machinery on the plantation, to the present time, when it is a separate industry in the hands of master ginneries.

104. SEED COTTON DRIER: INCREASING USE. By C. A. Bennett. (*Cotton Oil Press*, xviii., 12, 1935, p. 27. From *J. of Text Inst.*, xxvi., 8, 1935, A379.) The number of bales of Mississippi delta cotton dried artificially is increasing year by year. In the Government process the damp seed cotton is treated with a continuous current of hot air at a rate of 40-100 cubic feet for each lb. of cotton. The period of exposure to the drying blast may vary from fifteen seconds to three minutes, according to the design of drier used. The temperature of the drying air is between 160° and 200° F. for early season cotton.

COTTON SEED AND OIL.

105. COTTON AND COTTON SEED. Compiled by R. P. Lane. (*U.S. Dept. of Agr., Misc. Pubn. 203*, 1934. From *Exp. Sta. Rec.*, 72, 6, 1935, p. 763.) This is a list of the publications of the U.S. Dept. of Agriculture on cotton and cotton seed, including early reports of the U.S. Patent Office, and embracing 917 references, a list of depository libraries, and a subject and author index.

106. COTTON-SEED GRADING. By G. S. Meloy. (*Cotton Oil Press*, xix., 2, 1935, p. 49. From *Summ. of Curr. Lit.*, xv., 17, 1935, p. 432.) The chief basis of value in cotton seed is the quantity of oil and protein available, and the

grading of cotton seed, with respect to oil, free fatty acids, ammonia and moisture contents, is discussed. Monthly survey tables, and tables for the various American cotton States, are given.

107. SUR LES VITAMINES DE LA GRAINE DE COTON. By G. Brooks. (*Coton et Cult. Cotonn.*, ix., 2, 1934, p. 99.) The lipo-soluble A, the antirachitic A', and the hydrosoluble B have been found in cotton seed, and the author considers that they can be economically extracted by autoclave treatment, which destroys the gossypol.

108. COTTON-SEED FLOUR. AN INDUSTRIAL OPENING. (*Crown Colonist*, October, 1935, p. 453.) A description of the elaborate purifying processes by which cotton-seed cake is converted into an edible flour for mixing with wheat flour or other cereal meals. The flour is claimed to be highly nutritious, containing about 50 per cent. of protein. It is stated that 600 lb. of fine flour can be obtained from 1 ton of selected cotton seed.

109. COTTON-SEED MEAL AS THE PRINCIPAL SOURCE OF PROTEIN FOR DAIRY ANIMALS. By O. C. Cunningham and L. H. Addington. (*New Mexico Sta. Bull.* 226, 1934. From *Exp. Sta. Rec.*, 72, 6, 1935, p. 832.) From this study it is concluded that cotton-seed meal may be safely used as the principal source of protein in dairy rations if good quality roughage is fed.

110. COTTON-SEED BY-PRODUCTS: VALUE AS FOODSTUFFS. By G. A. Hale. (*Cotton Trade J., Internat. Ed.*, 1934-35, p. 31. From *Summ. of Curr. Lit.*, xv., 15, 1935, p. 383.) Cotton-seed meal is a valuable food for animals (cows, horses, mules), and would provide a flour containing 41 per cent. protein, suitable for human consumption. Cotton-seed oil has a high nutritive value.

PESTS, DISEASES, AND INJURIES, AND THEIR CONTROL.

111. COTTON AND ITS INSECT PESTS. By E. Hardy. (*Text. Rec.*, liii., 629, 1935, p. 21.) A brief popular account, showing what has been done to reduce losses from pests.

112. TECHNIQUE OF FIELD EXPERIMENTATION IN ENTOMOLOGY. II. THE REDUCTION OF DATA BY THE METHOD OF ANALYSIS OF VARIANCE. By L. L. Huber and J. P. Slesman. (*J. Econ. Ent.*, 28, 1, 1935. From *Exp. Sta. Rec.*, 73, 1, 1935, p. 69.) In this further report of studies at the Ohio Experiment Station, the details of which are presented in tabular form, the authors have attempted to show that it is not extremely difficult to analyse data by the method of variance when the experiment is properly planned.

[Cf. Abstr. 262, Vol. XII. of this Review.]

113. SECOND REPORT ON AN INVESTIGATION INTO THE BIOLOGICAL CONTROL OF WEST INDIAN INSECT PESTS. By J. G. Myers. (*Bull. Ent. Res.*, xxvi., 2, 1935. From *Rev. App. Ent.*, xxiii., Ser. A.9, 1935, p. 499.) This lengthy second report of investigations from September, 1930, to March, 1934, is introduced by some remarks on general aspects of biological control. An account is given of the ecological conditions of each of the regions visited in north-eastern South America, Panama, Florida, and the West Indies. A section on particular insect pests is arranged according to crops, and contains notices of the introduction of parasites. A summary of results and recommendations is appended.

[Cf. Abstr. 47, Vol. IX. of this Review.]

114. EXPERIMENTAL STUDIES IN INSECT PARASITISM. III. HOST SELECTION. By G. Salt. (*Proc. Roy. Soc.*, 117, No. B.805, p. 413, 1935. From *Rev. App.*

Ent., xxiii., Ser. A. 7, 1935, p. 390.) A detailed account of numerous experiments undertaken to discover some of the criteria by which ovipositing females of *Trichogramma evanescens*, Westw., select their hosts. Tests carried out with two strains, derived from one original female and reared through 63 and 43 generations on *Sitotraga cerealella*, Ol., and *Ephestia künniella*, Zell., respectively, showed that the eggs of *Ephestia*, which are larger, were preferred by both strains when they were given their choice of both hosts. When eggs of *Ephestia* were exposed with those of *Sitotraga*, *Bruchus obtectus*, Say, or *Agrotis pronuba*, L., when eggs of *Sitotraga* and *Ephestia*, differing in relative size, were exposed together, and when eggs of *Sitotraga* were placed with particles of sand or seeds of *Lobelia*, the parasite always preferred the larger hosts, in spite of the fact that the progeny could not develop in some and eggs could not even be laid in others.

115. NYASALAND. REPORT OF THE ENTOMOLOGIST, 1934. By C. Smeë. (*Rpt. Dpt. of Agr. Nyasaland*, 1934.) The work of the year was mainly devoted to investigations of *Nomadacris septemfasciata*. During the breeding season the activity of the hoppers was greatly reduced owing to the exceptionally wet weather experienced and severe attack by the fungus disease *Empusa grylli*. The movements of scattered bands of hoppers were practically negligible, and in most districts some bands failed to reach maturity. The movements of the swarms throughout the year are described. During the pre-breeding flights towards the end of the year the swarms were extremely large. The egg-pods laid by these locusts were infested by the grubs of *Mylabris* beetles and a Hymenopterous parasite, *Scelio* sp., was reared from eggs in the Cholo district. Fly parasites and nematode worms were present to a moderate extent in both hoppers and adults.

Pure hopper bands of *Locusta migratorioides*, which were not attacked by *Empusa grylli*, were only recorded from North Nyasa. Elsewhere this species occurred among bands and swarms of *Nomadacris septemfasciata*.

116. PESTS OF COTTON IN NORTHERN RHODESIA, 1934. (*Ann. Rpt. of Dpt. of Agr. N. Rhod.*, 1934.) Work on the stainer problem was continued on much the same lines as previously, but greater attention was devoted to the identification of the wild host plants, and a study of their flowering and fruiting, together with the recording of stainer populations on them. An attempt was made to control American bollworm by the use of maize trap-crops, but the traps failed to hold the moth, and did not prevent serious damage to cotton. Destruction by the Red Locust (*Nomadacris septemfasciata*) was not so severe, since the disease caused by the fungus *Empusa grylli* for the first time reached epidemic proportions and completely destroyed many of the hopper bands. A Dipterous parasite, the larva of a small fly (*Blæsozypha* sp. ?) also caused great mortality. Egg parasitism reached a high level, the most effective parasites being the larvæ of the fly *Stomatorrhina lunata* and of beetles of the genus *Mylabris*.

117. SOUTHERN RHODESIA. COTTON PESTS IN 1934. (*Rhod. Agr. J.*, xxxii., 8, 1935, p. 563.) From the report of the Chief Entomologist, 1934, we learn that American bollworm (*Heliothis obsoleta*) was of average intensity at Gatooma. The eggs were parasitized by *Trichogramma lutea* Gir. to the extent of 30-50 per cent., and in addition there was a fair percentage of egg destruction by *Orius* (*Triphleps*) sp. and other predators. Sudan bollworm damage was serious. Experiments with periodically stripped (every two or three weeks) standover cotton traps to attract the early season moths were promising. Stainers were responsible for a fair amount of injury, and jassid attack was more severe than usual. Aphis was less troublesome.

118. ECOLOGICAL STUDIES OF PINK BOLLWORM (*Platyedra gossypiella*, SAUND.). By M. A. Husain *et al.* (*Curr. Sci.*, **3**, No. 7, India, 1935. From *Exp. Sta. Rec.*, **73**, **2**, 1935, p. 212.) These notes relate to the biology of the pink bollworm as observed in the Punjab.

119. A TECHNIQUE FOR REARING THE CORN EARWORM (*Heliothis obsoleta*). By L. O. Ellisor. (*J. Econ. Ent.*, xxviii., **3**, 1935, p. 647.) Fully mature larvæ of *Heliothis obsoleta* collected from ears of maize during the last week in September and first in October were allowed to pupate in the greenhouse. Moths emerged in about two weeks, and were confined in a wire cage in and about which young maize was growing. Water and a sponge saturated with a 10 per cent. sucrose solution were placed in the cage. The sponge was washed and saturated each day. The moths fed readily on the solution and began to oviposit in two days after emergence, laying their eggs promiscuously on the sides of the cage and on growing maize. Most eggs hatched 4-5 days after oviposition; observations indicated that there was a high degree of fertility. The larvæ congregated on the maize touching the cage, and the plants were defoliated in a few days, with the exception of the tough mid-ribs and veins of the leaves and lower stems. Larvæ allowed to develop separately in glass jars containing maize kernels and damp sand were larger than those maturing on green maize. Moths began to emerge about November 20, and a second brood of larvæ was obtained from them. These were fed on rape, which proved an excellent substitute for maize, and, owing to its succulence and rapid growth, provided more food in the limited greenhouse space. The second brood of larvæ began to pupate about December 1, but the moths from these pupæ were weak and the eggs which they laid were infertile. The author believes that further study will make it possible to breed larvæ throughout the winter.

120. NOTE CONCERNANT LA MALADIE DU CHANCRE DES TIGES DU COTONNIER PRODUITE PAR l'*Helopeltis bergrothi*. By R. L. Steyaert. (*Bull. Agr. Congo belge*, xxv., **4**, p. 603. Brussels, 1934. From *Rev. App. Ent.*, xxiii., Ser. A., **7**, 1935, p. 378.) In view of criticisms of the author's conclusion that "shoot canker" of cotton in the Belgian Congo is not a fungus or bacterial disease, but the result of feeding of *Helopeltis* spp., he quotes extensively from a paper on the relation of a Capsid of this genus to the stem canker of tea in Nyasaland, which supports his view.

[*Cf. Abstr. 593, Vol. XI. of this Review.*]

121. DER "PERFORADOR DE LA BELLOTA" *Mescinia peruella* SCHAUS, EIN WICHTIGER SCHADLING DER BAUMWOLLE IN PERU (*Lep. Pyralidæ*). By J. Wille. (*Rev. Ent.*, iv., **4**, Rio de Janeiro, 1934. From *Rev. App. Ent.*, xxiii., Ser. A., **1**, 1935, p. 16.) In the coastal valleys of Peru the most important pest of cotton is the Pyralid, *Mescinia peruella*, Schaus. Cotton is its only known food-plant. All stages are described, and a detailed account of its biology is given from laboratory and field observations near Lima over a period of four years.

122. LOCUST INVASION IN THE ARGENTINE REPUBLIC, 1934-35. By J. F. Tomasello. (*Int. Bull. Pl. Prot.*, ix., **7**, 1935, M150. From *Rev. App. Ent.*, xxiii., Ser. A., **9**, 1935, p. 504.) Huge swarms, extending over 230 and even 300 square miles, were seen in the province of Entre Rios in July and August, 1934. Flame-throwers and barriers were used against newly hatched and older hoppers respectively.

123. NOTES ON THE LIFE HISTORY OF THE COTTON LOCUST, *Cyrtacanthacris rosea*, DE GEER. By K. Liu and C. Hwang. (In Chinese.) (*Ent. and Phytopath.*, iii., **2**, Hangchow, 1935. From *Rev. App. Ent.*, xxiii., Ser. A., **7**,

1935, p. 368.) In China, *Chondacris* (*Cyrtacanthacris*) *rosea*, De Geer, has one generation a year, and feeds on the flower buds, blossoms and bolls of cotton. Eggs collected in the field hatch in early June. The hoppers mature in about sixty days. The adults pair after about ten days, begin to oviposit a week later, and live about fifty days. Females lay 120-300 eggs each. The egg-pods are placed 2-3 inches deep in the soil.

124. LE MIEL DE PAYS COMME SUCCÉDANÉ DE LA MÉLASSE DANS LA PRÉPARATION DES APÂTS EMPOISONNÉS UTILISÉS DANS LA LUTTE ANTI-ACRIDIEUNE AU SOUDAN FRANÇAIS. By R. Dubois. (*Rev. Path. Veg.*, xxi., 2-3, Paris, 1934. From *Rev. App. Ent.*, xxiii., Ser. A, 9, 1935, p. 487.) In the French Sudan *Schistocerca gregaria*, Forsk., is mostly found north of 15° N. lat., while *Locusta migratorioides*, R. and F., is more injurious south of that latitude. The customary method of control is to use poison bait against crawling or stationary swarms. The bait consists of 8 lb. sodium fluosilicate, 12 lb. molasses and 200 lb. millet husks, horse dung, or chopped grass. Local honey, which is three times cheaper, may be used instead of molasses, which has to be imported.

125. LOCUST RESEARCH: EXPERIMENTS WITH *Empusa Grylli*. By A. McMartin. (*S. Afr. Sugar J.*, xviii., 11, Durban, 1934, p. 649. From *Rev. App. Ent.*, xxiii., Ser. A, 6, 1935, p. 278.) The author believes that confusion about *Empusa* and *Mucor* attacking locusts has existed for some time. Cultures of what had been thought to be *Empusa grylli* were sent to Kew from South Africa and identified as *Mucor exilis*. In laboratory experiments on the cultivation of *Empusa*, the first growth on potato slices repeatedly resembled that of *Empusa* on locusts, but the cultures were later overrun by a growth of bacteria, which was subsequently followed by one of *Mucor*. This started in the centre of the culture and spread outwards over the bacteria, but examination of the underlying potato tissue revealed the presence of unmistakable *Empusa*. Under the microscope the hyphæ of *Empusa* look as if they were full of bacteria, and it is tentatively suggested that *Empusa* is really a *Mucor*, growing in association with a possibly parasitic bacterium. *Mucor* probably originates on the food-plants of the locusts and the bacterium may be one of those normally found inside the insect itself; the two may unite within the locust at a certain stage in their biology, and continue as an apparently single organism, *Empusa*. It has been established that the *Mucor* is pathogenic, killing locusts in 5-6 days. A liquid medium is best for growing cultures, which do well in diluted molasses, sterilized by autoclaving. The insects are infected by being dipped into the culture. Experiments have been undertaken with cultures of fungus from different sources, and two types have proved pathogenic. One consists entirely of yeast-like growth, the other consists of both *Mucor* and the bacterium. Although locusts have been killed by the culture, no *Empusa* has developed as in nature, no external growth having appeared on the dead bodies to render them sources of infection.

126. ON THE BIOLOGY OF *Dysdercus howardi*, BALLOU (HEM). By E. I. MacGill. (Reprinted from *Bull. of Ent. Res.*, vol. xxvi., 2, June, 1935.) An account of investigations carried out on a number of cotton stainers (*Dysdercus howardi*) brought to Manchester University from Trinidad in 1932. The results are summarized as follows: At 27° C. the life cycle of *Dysdercus howardi* occupies approximately 32 days. Copulation (at 27° C.) takes place approximately 2-8 days after the last moult of the female insect. At 27° C. oviposition begins about 8 days after the last moult of the female, and 5-6 days after mating. The average number of eggs laid by one female is 141.9 and the average number of batches is two. Mortality appears to be highest among the 5th stage nymphs. The ratio of females to males is 1:1.27. The average length of adult life in the female

Dysdercus howardi is eleven days. A table comparing *D. howardi* with other species of the genus *Dysdercus* is given.

127. EGYPTIAN PLANT DISEASES: A SUMMARY OF RESEARCH AND CONTROL. By G. Howard Jones. (*Tech. and Sci. Serv. Bull.*, No. 146. Min. of Agr., Egypt, 1935.) A useful work of reference. The cotton diseases mentioned are: angular leafspot, sore shin, and wilt. Abstracts of the bulletins published in connection with these diseases have appeared in this Review from time to time.

128. ANGULAR LEAFSPOT OF COTTON. By R. B. Morwood. (*Queensland Agr. J.*, xliv., 1, 1935, p. 15.) The disease is believed to have been present in Queensland for a number of years, but until recently has not been regarded as of serious consequence in the State. The cause and symptoms are described, and also the usual preventive measures, including seed disinfection and the complete destruction of old cotton plants.

129. BLACKARM DISEASE IN UGANDA. By C. G. Hansford. (*E. Afr. Agr. J.*, i., 2, 1935, p. 131.) A brief history is given of the occurrence of the disease in Uganda, where it was first officially recorded in 1925. A discussion follows of the symptoms of the disease, the effect of climatic factors on the spread of infection, the possibility of spread by insects, the perpetuation of the disease from season to season, the injury caused to cotton plants, and the work devoted to the isolation of resistant varieties of cotton.

130. IL RAGGRINZIMENTO O ARRICCIAMENTO DEL COTONE NELLA SOMALIA ITALIANA. By G. Russo. (*Agr. colon.*, xxix., 2, 1935, p. 78. From *Rev. App. Mycol.*, xiv., 9, 1935, p. 579.) After briefly describing the symptoms of cotton leaf curl or crinkle as it occurs in Italian Somaliland, the author gives a full account of his investigations (carried out in the area concerned) into the nature and cause of the disease. He concludes that it is due, locally at least, to physiological factors set up by the high concentration of soluble alkaline salts in the soil resulting from the fact that the numerous deep cracks which are allowed to develop in the ground favour water evaporation by capillary action. The soil is very compact and sub-alkaline, and the irrigation water contains rather a large amount of chlorides, especially in the wet season. Further factors are the hot, dry, windy season in July and August, the rapid and considerable increase in the transpiration rate brought about by wind and sun, and the drop in temperature during the second half of July and the first half of August.

The author's experiments, in which insects taken from naturally diseased cotton in the field were fed on healthy plants with negative results, did not indicate that the form of leaf curl found locally belongs to the virus group of diseases. It is not found, even in the presence of insects, in fields where precautions are taken against the evaporation of soil moisture.

131. FIELD PRACTICES AFFECTING THE CONTROL OF COTTON ROOT KNOT IN ARIZONA. By C. J. King and C. Hope. (*U.S. Dpt. of Agr. Circ.* 337, 1934. From *Exp. Sta. Rec.*, 73, 1, 1935, p. 58.) The root knot disease caused by the nematode *Heterodera marioni* is reported as responsible for heavy damage to the irrigated cotton crop in certain light soil areas in Arizona, affecting attacked plants of the Pima Egyptian type of cotton more severely than it did infected Upland varieties. It caused a reduction in stands, stunting of the plants, suppression of fruiting branches, defoliation, and often death. Rotation every two or three years with alfalfa was found effective in maintaining satisfactory yields of Pima cotton, but was not effective in the eradication of the nematodes. Clean fallow maintained for two years by frequent cultivations or by a covering of mulch paper was effective in controlling the disease in the absence of irrigation,

and the results indicated that under the dry, hot conditions prevailing in Arizona a more prolonged period of fallow might terminate in eradication. Evidence was obtained that early irrigation reduced the severity of the disease in Pima cotton.

132. SOUTH CAROLINA. PLANT DISEASE STUDIES. (*S. Car. Sta. Rpt.*, 1934. From *Exp. Sta. Rec.*, 72, 6, 1935, p. 780.) Brief reports are included by C. H. Arndt on seedling diseases of cotton caused by the anthracnose fungus *Colletotrichum gossypii*, damping-off of cotton by *Pythium ultimum*, and the effect of nematodes (*Aphelenchoides parietinus*) on cotton seedling growth.

133. VIRUS DISEASES OF PLANTS: A BIBLIOGRAPHY. By D. Atanasoff. (Sofia Houdojnik Ptg. Co., 1934. From *Exp. Sta. Rec.*, 72, 6, 1935, p. 709.) The first section lists works on fundamental problems, the second lists works covering more than one virus disease, while the rest of the book gives the literature arranged alphabetically by author under each of 54 families, or their subdivisions, with a final section on insect vectors of viruses, followed by an author index. Probably 4,000 references to literature from the eighteenth century to 1933 are included.

134. A DESCRIPTIVE KEY FOR PLANT VIRUSES. By J. Johnson and I. A. Hoggan. (*Phytopathology*, xxv., 3, 1935, p. 328. From *Rev. App. Mycol.*, xiv., 8, 1935, p. 521.) Discusses the need for a more complete and systematic description of plant viruses. The following are believed to be the chief diagnostic features of a virus that are of value for descriptive purposes: (1) modes of transmission; (2) natural or differential hosts; (3) longevity *in vitro*; (4) thermal death point; and (5) certain distinctive or specific symptoms. Transmission by sucking insects and the identity of the vector concerned, together with mechanical transmission by plant extracts and transmission by grafting, are considered to provide the main bases for differentiation. Utilizing chiefly these criteria, a descriptive key for plant viruses is given in tabular form, placing some fifty of the known viruses in several fairly well-defined groups bearing a certain natural relationship to one another, further intensive study of which may furnish a logical foundation for classification.

GENERAL BOTANY, BREEDING, ETC.

135. DROUGHT RESISTANCE AND EARLINESS IN COTTON. By V. N. Tsivinskii. (*Shredaz NIHI*, Moscow and Tashkent, 1934. From *Pl. Bre. Absts.*, vi., 1, 1935, p. 64.) The results of observations showed that transpiration rate was related in a certain measure to drought resistance, but with a number of reservations. The concentration of the sap was not so associated, and the character of the root system was found to be an important consideration.

136. LE *Gossypium Anomalum* EST UN COTONNIER. By A. Chevalier. (*Rev. Bot. Appl.*, 15, 1935, p. 369. From *Pl. Bre. Absts.*, vi., 1, 1935, p. 62.) Genetic confirmation of the author's contention that *G. anomalum* Wawra et Peyr. belongs to the *Gossypium* and not to the *Cienfuegosia* group.

[Cf. Abstr. 625, Vol. X. of this Review.]

137. THE VARIETY NO. 36 M, "PAKHTAKOR." By A. T. Svetasev. (*Bull. Cent. Asia Sci. Res. Cott. Inst. (NIHI)*, No. 2, p. 6. Tashkent, 1934. From *Pl. Bre. Absts.*, vi., 1, 1935, p. 62.) This new cotton was produced by selection from Acala, which when received from America was in a very impure state. The new selection is distinguished by high yielding capacity and extremely high quality of lint, in which it excels the standard Navrotskii: its average lint length is 30-35 mm. spinning 40-50's; its ginning outturn is slightly higher than

Navrotskii, and the bolls, although of the same size, are more abundant. It is 3-5 days later than Navrotskii, to which, however, it is superior in having a more compact habit of growth.

138. CROSS-POLLINATION IN COTTON. By S. P. Pod'japol'skii. (*Bull. App. Bot.*, Ser. A, 12, p. 141. Leningrad, 1934. From *Pl. Bre. Absts.*, vi, 1, 1935, p. 63.) The results of experiments showed that the amount of contamination caused by the presence of a few foreign plants in a pure culture of cotton is extremely small, amounting to a fraction per cent., and this percentage rapidly falls as the distance from the impurity increases. However, the degree of contamination occurring in a single plant by out-pollination from the surrounding population is very much higher, and the common method of estimating the degree of cross-pollination by examining the progeny only of the green plants is seen to be definitely fallacious.

139. THE EXTENT OF CROSS-POLLINATION IN COTTON. By Y. Naghibin and E. Uzembayev. (*Bull. Cent. Asia Sci. Res. Cott. Inst. (NIHI)*, No. 2, p. 33. Tashkent, 1934. From *Pl. Bre. Absts.*, vi, 1, 1935, p. 63.) A strip of a red-leaved Upland variety, No. 1617, was sown in the centre of a field of the new variety 8516 having green leaves; the seeds were collected and their progeny examined in the following season. The results of the examination showed that the highest percentage of cross-pollination, amounting to 5.22 per cent., occurred in the rows adjacent to the strip, and diminished rapidly with increasing distance from the strip. It is calculated that, since this cross-pollination is effected by insects, spatial isolation is thoroughly reliable only when the distance of isolation is equal to 1 km., though isolation at a distance of 15 m. has given practically satisfactory results. There was a difference in degree of cross-pollination to the east and west of the strip, connected with the direction of the prevailing winds.

140. NATURAL CROSS-POLLINATION OF COMMERCIAL COTTON VARIETIES. By M. Malinkovsky. (*Bull. Cent. Asia Sci. Res. Cott. Inst. (NIHI)*, No. 2, p. 41. Tashkent, 1934. From *Pl. Bre. Absts.*, vi, 1, 1935, p. 62.) Sowings were made of a number of varieties in alternate rows, in a field where a quantity of other lines were also grown, thus under conditions favouring the maximum degree of cross-pollination. The examination of the progeny in the following year showed that the average cross-pollination for all the Upland varieties was 4.62 per cent., 2.87 per cent. of the progeny being hybrids with plants of the adjacent row and 1.84 per cent. with other plants, evidently produced by out-pollination by insects. Different varietal combinations, however, gave differing degrees of cross-pollination, one group showing 6.85 to 8.48 per cent., another only 0 to 4.70 per cent. The degrees of pollination observed in the different varietal combinations are tabulated; the highest percentages were observed in the forms with compact habit.

The low degree of contamination observed under these optimum conditions leads to the conclusion that out-pollination need not be a serious source of impurity in select material if proper control of the nursery and of the seed is observed.

141. AN INTERSPECIFIC HYBRID BETWEEN AMERICAN AND ASIATIC COTTON PLANTS, AND ITS PROGENIES. By S. Nakatomi. (*Proc. Crop. Sci. Soc.*, 7, p. 3. Japan, 1935. From *Pl. Bre. Absts.*, vi, 1, 1935, p. 64.) Attempts to produce the hybrid between old-world cotton ($n=13$) and new-world cotton ($n=26$) were largely unsuccessful. After seven years the author obtained six F_1 plants from the cross King's Improved (new world) $\times$ Manchurian Black (old world), and one F_1 from Egyptian (new world) $\times$ Manchurian Black. On pollinating the latter with King's Improved two seeds were obtained, one of which developed,

the plant flowering and setting fruit. This plant somewhat resembled King's Improved, but had characters of all three parents. Its chromosome number was $n=26$, and it was partially fertile, with about 10 per cent. fertility on self-pollination, and about 20 per cent. when pollinated with King's Improved. After the two types of pollination, the respective percentages of ginned cotton obtained varied from 25.00 to 40.80 and from 21.5 to 48.80; the respective lengths of fibre varied from 23 to 29 mm. and from 23 to 26 mm. Nineteen offspring were obtained in all, six from self-pollination and thirteen from the back-cross. The plants varied a great deal in all characters. The back-cross progeny had more good pollen (47.74 to 88.92 per cent. as against 21.40 to 40.84 per cent. in the progeny from self-pollination). The percentage of ginned cotton in the self-pollination progeny varied from 28.09 to 40.84 per cent., and in the back-cross progeny from 33.12 to 43.75 per cent., while the lengths of fibres of the respective progenies were 24.35 to 36.70 mm. and 20.30 to 29.80 mm.

142. MEMOIRS OF THE COTTON RESEARCH STATION, TRINIDAD. (Pubd. by the Empire Cotton Growing Corporation, price 2s. 6d., post free.) The eleventh number of Series A, Genetics, has recently been issued, and contains the following paper reprinted from the *Journal of Genetics*:

CHROMOSOME NUMBERS IN THE MALVACEÆ—I. By A. Skovsted. In the present study the chromosome numbers of about 120 species, representing 25 genera of the family Malvaceæ, have been described. The following chromosome numbers, were found: 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 21, 22, 25, 26, 28, 33, 35, 36, 38, 39, 42, 46, 56 and 65.

Evidence has been presented in favour of the following chromosome series: (a) a five series (5, 10, 15, 25); (b) a six series (12, 18, 36); (c) a seven series (7, 14, 21, 28, 35, 42, 56); (d) an eleven series (11, 22, 33); and (e) a thirteen series (13, 26, 39, 65).

In most genera all species examined are members of the same chromosome series (i.e., *Althæa*, *Pavonia*, *Gossypium*). Some genera, however, contain different chromosome series—i.e., *Abutilon* (8 and 7 series); *Malvastrum* (12 and 15 series, and a few numbers represented by a single specimen); and *Hibiscus* (11, 12 (18, 36), 14 (28), 17, 19, and several others). The cytological groups in these genera appear to be associated with taxonomical groups or certain morphological characters.

143. MEMOIRS OF THE COTTON RESEARCH STATION, TRINIDAD. (Pubd. by the Empire Cotton Growing Corporation, price 2s. 6d., post free.) The twelfth number of Series A, Genetics, has recently been issued, and contains the following paper reprinted from the *Journal of Genetics*:

THE GENETICS OF COTTON—Pt. XV.: "The Inheritance of Fuzz and Lintlessness and Associated Characters in Asiatic Cottons." By J. B. Hutchinson. Tufted seed (T) is shown to differ in a single gene from fuzzy (*t*), giving an intermediate heterozygote. The identity of the gene for tufted with that for semi-tufted is established. The modifying factors responsible for the difference between tufted and semi-tufted cause the heterozygote to be almost or completely indistinguishable from fuzzy, and are the same as those responsible for the difference between thick and thin fuzz on fuzzy seeds. One of these modifiers is located in the brown lint-leaf shape linkage group. Fuzz modifiers, but not the main tuft factor, affect slightly the hairiness of the plant body. A long lint factor and a seed weight multiple allelomorph series are located in the same chromosome as the tufted factor. There were no other associations between lint characters and fuzz characters. The tufted factor and the lintless factor are independent. Tufted assorted freely with: leaf shape, anthocyanin pigment, corolla colour, lint colour (3 factors), leaf nectaries. No satisfactory evidence of linkage was

obtained between the lintless factor and leaf shape, anthocyanin pigment, corolla colour, leaf nectaries.

144. CHROMOSOME MECHANICS. By C. D. Darlington. (*Bull. App. Bot.*, Ser. 2 (6), p. 237. Leningrad, 1934. From *Pl. Bre. Absts.*, vi., 1, 1935, p. 29.) A very brief outline of the author's theory of mitosis and meiosis.

145. THE OLD TERMINOLOGY AND THE NEW ANALYSIS OF CHROMOSOME BEHAVIOUR. By C. D. Darlington. (*Ann. Bot.*, 49, 1935, p. 579. From *Pl. Bre. Absts.*, vi., 1, 1935, p. 1.) The author states that an elaborate terminology has been built up containing numerous terms of doubtful significance, and he appeals for the use of more logical methods, using all relevant information from both genetics and cytology.

146. PHOTOPERIODISM OF THE COTTON PLANT. SOME RESULTS OF EXPERIMENTS ON THE INFLUENCE OF CHANGES IN THE DURATION OF ILLUMINATION UPON THE DEVELOPMENT OF THE COTTON PLANT. By N. N. Konstantinov. (*Sredaz NIHI*, Moscow and Tashkent, 1934. From *Pl. Bre. Absts.*, vi., 1, 1935, p. 62.) By suitably adjusting the length of day it is possible to induce the most diverse cottons to flower simultaneously, and by this means crosses have now been made between the Egyptian cottons, with low boll weight, and a number of the South American cottons, *Gossypium peruvianum*, *G. brasiliense*, etc., which, though perennial in habit, have very large bolls, weighing up to 7 and 8 g.: these cottons are phylogenetically close to the Egyptian cottons *G. barbadense*. The F_1 hybrids are also perennial in habit and must also be treated with short day.

147. COTTON PLANT: WATER CULTURE EXPERIMENTS. By V. S. Ivanova. (*Lenin Acad. Agr. Sci., Gedroiz Inst. Fertilizers Agro-Soil Sci.*, 3, 1934, p. 77. From *Summ. of Curr. Lit.*, xv., 19, 1935, p. 507.) Studies are reported on the effects of Ca, Mg, PO_4 , Cl and SO_4 ions on the utilization of ammonia and nitrate by cotton in solutions at pH 3.5, 4.8, and 7.0. In general, pH appears to be the most important factor.

FIBRE, YARN, SPINNING, WEAVING, ETC.

148. BRITISH COTTON INDUSTRY RESEARCH ASSOCIATION. (*Rpt. of 16th Ann. Gen. Mtg.*, 1935.) In his speech the Chairman, Mr. H. S. Butterworth, stated that the new buildings necessary for the extension and development of the research work would be completed early in 1936, and would add more than 50 per cent. to the accommodation of the Institute. In addition, negotiations were practically complete for the setting up at the Institute of a department for research work on silk similar to that on rayon.

Dr. R. H. Pickard, the Director of Research, in his remarks, stated that the number of enquiries from mills had grown from year to year, and the contact of the staff with the trade had been largely increased.

149. THE HANDLING OF COTTON WITH COTTON IN PLACE OF JUTE. By W. L. Balls. (*Int. Cott. Bull.*, xiii., 52, 1935, p. 633.) The presence of jute fibres in cotton is the cause of a high percentage of yarn breakages, and it is suggested that cotton sacks and coverings, instead of hessian, should be used in handling the crop. The cost of the change-over to cotton bagging, and the extra value of jute-free cotton to the spinner, are discussed.

150. COTTON BALE BAGGING: ADVANTAGES. By E. O. Jewell. (*Cotton Trade J., Internat. Ed.*, 1934-35, p. 144. From *Summ. of Curr. Lit.*, xv., 15, 1935, p. 383.) The advantages are enumerated of baling cotton in cotton instead of jute bags.

The fire hazard is reduced, the cotton arrives in better condition, and this increased use of cotton would benefit the cotton industry. The adoption of net weight trading is strongly recommended.

151. THE HUMIDITY OF RAW COTTON AND THE DETERMINATION OF ITS MERCANTILE WEIGHT. By C. Levi. (*Int. Cott. Bull.*, xiii., 52, 1935, p. 732.) The question of the control of humidity and of the consequent commercial weight of the lots of raw cotton purchased by European spinners has been to the fore for many years, but as yet no logical solution to it has been found. In consideration of the doubts still existing on the matter, the author has briefly reviewed the whole subject, approaching it from three different viewpoints, which prove their reciprocal interdependence; these are: (1) the hygroscopic property of the fibre, and the study for the determination of the correct value of the standard amount of moisture under normal conditions of humidity; (2) methods for the experimental control of the commercial weight and their unification; (3) commercial negotiations and agreements in respect of the moisture.

152. FIBRE MATURITY IN RELATION TO FIBRE AND YARN CHARACTERISTICS OF INDIAN COTTONS. By A. N. Gulati and N. Ahmad. (*Tech. Bull.*, Ser. B., No. 20, 1935. *Ind. Cent. Cott. Comm.*) This report contains an account of an investigation undertaken with the object of determining the effect of season, locality of growth, heredity, etc., on the fibre maturity of Indian cottons, the relationship of the latter with the mean length, fibre-weight per inch and fibre-strength of these cottons, and its influence on the neppiness and strength of the yarns spun from them. The technique employed in the tests is described in detail.

153. TAKING PHOTO-MICROGRAPHS OF COTTON FIBRES. By A. G. Arend. (*Text. Rec.*, liii., 629, 1935, p. 22.) The use of the projection microscope is discussed.

154. COTTON HAIR: MATURITY DETERMINATION BY POLARIZED LIGHT. By W. E. Stevens. (*Text. World*, 85, 1935, p. 1475. From *Summ. of Curr. Lit.*, xv., 18, 1935, p. 472.) The appearance of cotton hairs in polarized light is described, and it is shown that this may be used as a basis for determinations of maturity. A system is described in which the hairs are classified as highly unmaturred, unmaturred, maturred, and highly maturred, and the percentages of each class in a sample are determined. Maturity ratings obtained in this way often reveal differences between lots classed as the same by experienced cotton classers, and explain the differences in the strengths of the yarns produced from them. Some typical results are given.

155. THE RELATIONSHIPS BETWEEN SOME PROPERTIES OF COTTON HAIRS AND THE SPINNING QUALITY OF THE COTTONS. By C. Underwood. (*Shirley Inst. Mem.*, vol. xiv., 1935.) This paper describes the results of statistical analyses applied to data obtained from spinning tests carried out at the Shirley Institute for the Empire Cotton Growing Corporation, the Egyptian Cotton Research Board, and other similar organizations. The object of the analyses was to discover relationships which might exist between certain properties of cotton hairs and the spinning quality of the cottons, with a view ultimately to constructing a prediction formula by which the spinning quality of a cotton could be assessed from a knowledge of the properties of the hairs. The results obtained indicate, however, that it is unlikely that an accurate prediction formula can be established by statistical methods until further knowledge is available of the mechanism of drafting, and of yarn structure.

The paper is divided into two main sections. Part I. describes analyses of the results obtained from 371 samples ranging in type from the longest Sea Island cotton with a staple length of practically 2 inches, spun into 200's yarn, down to a short and coarse African cotton spun into 10's. Three separate

analyses were made: A, of the 371 samples treated as a whole; B, of 206 out of the 371 which are of American type grown in Empire fields; and C, of the remaining 165 samples, which are mainly of Egyptian type. In this part, one yarn property—Highest Standard Count—and three hair properties—length, fineness, and maturity—were investigated.

Part II. describes the results of an analysis made on smaller groups of Empire cottons—114 in all—representing growths of more or less similar types, but differing considerably in spinning quality. This analysis involved two yarn properties—lea strength and work of rupture—and nine hair properties, including length, irregularity of length, hair-weight per centimetre of long, medium, and short hairs, percentage of “normal” hairs and percentage of “dead” hairs.

The relations between hair properties themselves were also studied, and the results are discussed.

156. COTTON MILL: FIRE HAZARDS AND PROTECTIVE MEASURES. By P. R. Lowe. (*Text. World*, **85**, 1935, p. 246. From *J. Text. Inst.*, xxvi., **8**, 1935, A423.) It is advised that bales should be stored in one layer, vertically. If they must be piled, there should be at least 3 feet of free space below the sprinklers and the stack should be sub-divided by frequent clear alley-ways, so as to minimize the risk of a “burrowing” fire.

157. THE ALTERATION IN SPINNING TECHNIQUE INVOLVED ON CHANGING OVER A COTTON MILL FROM SHORTER STAPLES TO EGYPTIAN COTTONS. By W. Dunkerley. (*Text. Wkly.*, xvi., **397**, 1935, p. 381, and subsequent numbers.) The prime factors governing the alterations necessary are: (a) the physical properties of the two types of cotton, which will determine the treatment necessary for the best results; (b) the counts of yarn to be spun as compared with those already being spun; (c) the machinery available.

158. COTTON AND STAPLE FIBRE: SPINNING VALUE. By O. Johannsen. (*Leipz. Monats. Text. Ind.*, **50**, 1935. *Fachheft* ii., p. 32. From *Summ. of Curr. Lit.*, xv., **20**, 1935, p. 530.) A sample of cotton and a sample of staple fibre are compared in regard to strength, extensibility, staple length, fineness, structure, regularity of staple and flexibility, and the spinning value of cotton-staple fibre mixtures is briefly discussed.

159. SINGLE-THREAD STRENGTH TESTING OF YARNS IN VARIOUS LENGTHS OF TEST SPECIMEN. By D. F. Kapadia. (*J. Text. Inst.*, xxvi., **8**, 1935, T242.) From the analysis of results given by the three kinds of strength tests—observing the effect of yarn breakages in spinning, assessing the evenness of the yarn, and examining the fibre test data—it is proved that an increased knowledge of the fundamental differences of strength property of yarns of the same lea value can be derived. By the adoption of such a technique in the laboratory it becomes possible to form trustworthy judgments of the quality of cottons supplied for spinning tests.

160. RECENT DEVELOPMENTS IN COTTON MACHINERY. By F. Nasmith and W. English. (*Int. Cott. Bull.*, xiii., **52**, 1935, p. 681.) Since the authors prepared their previous paper on this subject [*Cf. Abstr.* **305**, Vol. XI. of this Review], there have been a number of interesting developments in cotton machinery. These have been mainly concerned with adaptations to and modifications of existing types of machines, rather than with the introduction of new machines embodying revolutionary changes in principle. The present paper gives much useful information regarding the latest developments in connection with blow-room, cardroom, spinning and doubling, gassing, processing, weaving, knitting, and testing machinery, and in the adaptation of cotton machinery for spinning staple fibre.

161. MAKING MORE OF MASS PRODUCTION. NEW DESIGNS IN TEXTILE MACHINERY. By F. Nasmith. (*World Textiles*, pubd. by *Man. Guar. Coml.*, October 4, 1935.) A survey of the textile machinery developments of the past twelve months, and a detailed examination of some of the new devices that may have a very distinct bearing on the internal organization of our spinning mills and weaving sheds in the future.

TRADE, CO-OPERATION, ETC.

162. WAGES AND LABOUR IN THE LANCASHIRE COTTON-SPINNING INDUSTRY. By J. Jewkes and E. M. Gray. (Pubd. University Press, Manchester, 1935. price 8s. 6d. net. Reviewed in *Text. Wkly.*, xvi., 395, 1935, p. 327.) A survey of the whole question completed by the Economics Section of the University of Manchester.

163. WORLD'S COTTON CROP: PRODUCTION SINCE 1870. By A. H. Garside. (*Cotton Trade J., Internat. Ed.*, 1934-35, p. 18. From *Summ. of Curr. Lit.*, xv., 15, 1935, p. 382.) A table is given of the yearly production of cotton in U.S.A., and in foreign countries from 1870 up to the present time. During this period the total production has quadrupled. The percentage of the world total supplied by U.S.A. is indicated.

164. WORLD'S COTTON CROP: VARIATIONS IN PRODUCTION AND CONSUMPTION. By H. P. Demidov. (*Cotton Trade J., Internat. Ed.*, 1934-35, p. 29. From *Summ. of Curr. Lit.*, xv., 15, 1935, p. 406.) The causes of the variations in world cotton production and consumption are discussed.

MISCELLANEOUS.

165. IMPERIAL COLLEGE OF TROPICAL AGRICULTURE. The Principal's Report for 1933-34 records the progress made with the training of agricultural and research officers and with research, and shows that throughout the year the work of the College proceeded smoothly. Long-range research, as in the past, centred round the four crops of major importance in Trinidad—viz., sugar-cane, cacao, bananas, and citrus—and the work on these crops is described. The investigation work carried out by the departments of Agriculture, Botany, Economics, Entomology, Mycology, and Bacteriology is also described. The total number of students in residence was 45, or 6 less than in 1932-33. Fifty-four scientific papers were published during the year, including those written for *Tropical Agriculture*.

166. ANNUAL COTTON HANDBOOK, 1935. (Compiled and published by Comtelburo, Ltd., 11, Tokenhouse Yard, London, E.C. 2.) We have received a copy of the sixty-fifth number of this handbook, which is a useful publication for recording daily the receipts and quotations of American, East Indian and Egyptian crops. Many statistical tables are also included in the volume.

167. SKINNER'S COTTON TRADE DIRECTORY OF THE WORLD, 1935-36. (Pubd. annually in October by Thos. Skinner and Co., London, Manchester, Bradford, Montreal, New York.) The thirteenth issue of this indispensable work of reference of the world's cotton industry. The customary revision of details, in collaboration with the leading Textile Associations throughout the world, has been carried through, and valuable additions have been made to the particulars previously published. In view of the increasing use of Rayon Staple Fibre, a list of companies handling this product has been included in the Silk and Rayon section. The Hosiery and Knit Goods Manufacturers section has been considerably augmented, and wherever possible the type of machines used and the articles

manufactured have been indicated. The trade names of articles manufactured by many firms and companies in this section are also included. The thumb-holes for ease of reference are labelled: Contents; Index; Exporters, Merchants; Spinners, Manufacturers and Doublers; Directors (British); Dyers, Finishers; Fabrics; Silk and Rayon; Hosiery and Knit Goods; Mill Supplies. As usual, all headings, indices, and explanatory notes are given in English, French, German, Italian, Spanish, and Portuguese. The directory is invaluable to all those connected in any way with the cotton industry. The price by post, inland and abroad, is £1; Canada and United States, \$7 (post and duty free).

168. TEXTILE RECORDER YEAR BOOK, 1935. (Harlequin Press Co., Ltd., Manchester 2.) The statistical data, tables of production, etc., which form a prominent feature of the volume, have been brought up to date and revised where necessary. New matter, to the extent of some sixty pages, is included. The sections dealing with High Drafting of Cotton and the Bleaching, Dyeing and Finishing of Rayon have been entirely revised and brought up to date, while among the new articles mention may be made of those dealing with Lastex Yarn and Lactron Thread, and Rayon Staple Fibre. A bibliography of new textile inventions is also included, and a list of new textile companies registered during 1934, with particulars of their activities, directors, capital, etc., is another useful feature.

ADDENDUM.

169. THE MANUFACTURE OF HUMUS BY THE INDORE PROCESS. By Sir Albert Howard. (*J. of Roy. Soc. of Arts*, lxxxiv., 4331, 1935, p. 26.) In a lecture at the Royal Society of Arts on November 13, Sir Albert Howard continued the one given two years previously. He began by explaining that humus is a mixture of substances consisting of (1) the remains of plants and animals which are undergoing decomposition in the soil, (2) substances like lignified cellulose which are more resistant to decay, and (3) a number of valuable materials which have been synthesized by the groups of micro-organisms which form the soil population. It thus arises from a mass of heterogeneous substances which are constantly undergoing oxidation, and when this slows down the resultant humus product can be incorporated with the soil.

Humus has a carbon-nitrogen ratio of about 10:1, prepared from vegetable and animal wastes with a ratio of about 33:1. Much air is therefore needed for the evolution of CO_2 ; also water, a base to neutralize excessive acidity, and sufficient minerals, especially combined nitrogen, so that its demands are much like those of the roots of plants, and it should not be prepared in the soil itself or it may interfere with growth, as has been noticed in cases of green manuring, of the addition of straw to the soil, etc. The Chinese were the first to grasp and act upon the master idea that growth of a crop involved two separate processes—the preparation (outside) of humus, and the growing of the crop. This is what is done in the Indore process, which is now spreading over the world, and bidding fair to effect an important revolution in agriculture. A number of examples are brought forward showing how the process is coming into favour on estates growing tea, coffee, sugar, sisal, and other tropical products. Here the centralization of the industries has enabled action to be rapidly undertaken upon large areas, but in peasant industries like cotton, a much slower rate of progress is to be looked for. Cotton in India suffers from the limiting factor of poor aeration after sowing—a colloidal condition of the soil establishes itself about the middle of the rains, or even earlier in wet seasons, and dressings of Indore compost tend to improve the permeability of the soil. The process is already established on all the Government farms in Sind, and is being taken up by the zemindars. It is

also used on a large scale in the United Provinces, the Nizam's dominions, and elsewhere. Various improvements and modifications of the original process have been made by Messrs. Jackson and Wad and others. The process is also being taken up in Africa.

The utilization of town wastes is dealt with, and the general application to British agriculture of the principles inherent in the Indore process is discussed.

An interesting and informative lecture that should be read by all interested in tropical (and other) agriculture.

[*Cf.* Abstr. 43, Vol. IX. and 218, Vol. XI. of this Review.]

PERSONAL NOTES

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are on the Fourth Floor of King's Buildings, Dean Stanley Street, Millbank, S.W. 1.

At the date of writing the following officers are on leave, or will shortly be arriving in England from cotton-growing countries:

Ceylon	...	...	...	...	...	Mr. R. E. Ponniah.
"	...	...	...	...	...	Mr. W. Youngman.
Cyprus	...	...	...	...	...	Mr. C. G. Pelagias.
Fiji	...	...	...	...	...	Mr. W. L. Parham.
Gold Coast	...	...	...	...	...	Mr. J. L. Scott.
"	...	...	...	...	...	Mr. A. Steele.
Kenya Colony	...	...	...	...	...	Mr. J. E. P. Booth.
Nigeria	...	...	...	...	...	Mr. D. W. H. Baker.
"	...	...	...	...	...	Mr. R. B. Shorter.
Nyasaland	...	...	...	...	...	Mr. B. C. G. Charles.
Northern Rhodesia	...	...	...	...	...	Mr. G. Walton.
Tanganyika Territory	...	...	...	...	...	Mr. F. R. Sanders.
Uganda	...	...	...	...	...	Mr. C. W. L. Fishlock.
"	...	...	...	...	...	Mr. R. W. Stuckey.
West Indies	...	...	...	...	...	Mr. R. W. R. Miller.
Zanzibar	...	...	...	...	...	Mr. R. E. T. Hobbs.
"	...	...	...	...	...	Mr. F. B. Wilson.

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AMERICAN COTTON LEGISLATION

BY

JOHN A. TODD, M.A., B.L.

IN two previous articles* the writer has outlined from time to time the development of the multifarious attempts of the American Government to influence the price of cotton by various legislative measures. Before attempting to bring the history of that legislation down to date it is necessary to recall the main lines of these attempts, which were as follows:

1. As far back as 1929 the Federal Farm Relief Board began a policy of lending, or providing funds for the Co-operatives to make loans, to the planters in order to enable them to hold their cotton. The result of this was that quite unintentionally the Government drifted into becoming the owners of considerable quantities of cotton out of the 1929 and subsequent crops. The basis of the original loans in 1929 had been 16 cents, but after the catastrophic fall of prices the Government had in effect to hand this cotton back to the planters under an "option" early in 1933 at 6 cents. In September of that year a new loan scheme was inaugurated on a 10 cents basis, and in 1934 this was again raised to 12 cents. The result was that at the close of the 1934-35 season the Government held altogether under these various loans about six million bales of cotton.

2. Under the Agricultural Adjustment Administration scheme (always known as the A.A.A.), which was the parallel of the similar scheme for industry, the National Industrial Recovery Administration (known as the N.R.A.), the Government in each season since 1933 has adopted various measures to restrict the acreage on which cotton was actually grown, by in effect paying the growers not to grow cotton on a certain percentage of their land.

3. Following upon the experience of 1933, when, in spite of the ploughing under of fully ten million acres already planted, the crop,

* *Finance, America and Cotton Prices*, Vol. XI., p. 1 (January, 1934), and *American Cotton Legislation*, Vol. XII., p. 103 (April, 1935).

owing to a bumper yield, proved to be almost as big as in the previous year, the Government in 1934 determined to make sure of a definite restriction of the crop, and the Bankhead Act, passed in April, 1934, limited the quantity that could be ginned by a quota fixed for each county and state on the basis of its previous production, and any excess over the quota could only be marketed under a penalty of a tax of 50 per cent. of the current price.

4. Finally the Government has followed a policy of inflation or price-raising by devaluing the dollar by stages; this culminated in January, 1934, in fixing the gold price at \$35.00, which meant a devaluation to 59.06 per cent., as against the maximum power conferred on the President under the Agricultural Relief Act in April, 1933, to reduce it to 50 per cent. A further measure, which was quite frankly, so far as its promoters were concerned, intended as inflationary, was the Silver Purchase Act of June, 1934.

Our second article (April, 1935) brought the narrative down to February 18, 1935, when rather to everyone's surprise the Supreme Court upheld the constitutionality of the Gold Clause, which put into effect the devaluation of the dollar. As the major developments of the situation since that date have largely centred round the various decisions of the Supreme Court, the easiest way to make a long story intelligible will be to follow out these further decisions in chronological order.

In May, 1935, the Supreme Court staggered the whole country by declaring the N.R.A. unconstitutional, on the ground that Congress had no right to *delegate* to the President whatever powers it possessed of regulating wages and hours of industry and prices, as he in effect did by setting up the N.R.A. Codes. Behind this, of course, lay the much more important question whether Congress itself had such powers of control, even if it had exercised them directly by legislation. This, of course, raised the old bugbear of American legislation in the question of state rights—*i.e.*, whether the Federal Government has any power over such matters except to a limited extent in inter-state commerce, the argument being that only the forty-eight separate state legislatures have such powers of control in their own territories.

It was feared that this decision would result in many more of the President's legislative schemes meeting the same fate, especially the A.A.A., and in the hope of anticipating possible objections to the original Act a new Farm Bill was introduced in June, 1935, which, however, made no material alteration in the terms of the acreage restriction scheme. Latterly, therefore, this fear seemed to have

been forgotten, and in any case the authorities in Washington repeatedly assured the market that whatever might be the decision of the Supreme Court on the A.A.A., they had alternative legislation prepared which would meet any difficulty that could arise. It was therefore a great shock to the market when on January 6, 1936, the Supreme Court handed down a decision which went much further than anyone had anticipated. The immediate object of the attack in the case had been the processing taxes which were imposed on the production of cotton goods in order to provide the funds for the payments to the farmers under the area restriction schemes; but the Court, not content with finding these taxes illegal, rather went out of their way to declare that the whole business of the A.A.A. was unconstitutional, because Congress had no powers under the constitution to regulate either industry or agriculture, that being the exclusive business of the separate states.

This sweeping decision seems to have taken the agricultural authorities at Washington completely by surprise, and it soon became evident that their promise of substitute legislation was more than they could fulfil. In the meantime, however, it may be noted that another case still awaited the decision of the Supreme Court, which raised the question of the constitutionality of the Bankhead quota; but in February Roosevelt, anticipating what everyone expected would be the decision, asked Congress to repeal the Bankhead Act, which was promptly done.

Before proceeding to describe the measures which the authorities did ultimately produce to replace the A.A.A. we must go back to narrate the developments of the Government's policy both as regards area restriction and loan policy in 1935, and area restriction for 1936.

In the second article it was explained that in November, 1934, the Government had, after much hesitation, announced the maximum restriction of 25 per cent. on the acreage for 1935 (against 40 per cent. in 1934), and in December the Bankhead quota was re-enacted for 1935. In March, 1935, however, the market went through a curious psychological reaction, which produced a revision of the legislation for 1936. For a long time they had been nagging at the Government to produce details of their 1935 loan scheme, which was quite unreasonable because the practice of the Government in previous years had always been not to announce the figure of the loan until they had some idea of the probable size of the crop. The details of the Bankhead quota were also under discussion on the proposed legislation to omit the grower of less than two bales from the quota. On March 11 a rumour was started in the market that the Government had decided

to have no loan in 1935, and that the Bankhead quota was going to be extended so far that it would be quite ineffective, and such was the peculiar temper of the market at the time that on these rumours New York fell nearly two cents after the close of the Liverpool market that day. The Government, of course, had to take immediate action to check this panic, and they did so by introducing an optional further reduction of acreage by 35 per cent., and finally by declaring that the two-bale exemption under the Bankhead Act would not affect the total limit of the quota, which was still about 10,500,000 bales.

When the first acreage estimate appeared on July 8, 1935, it was found that the result of the new 25-35 per cent. restriction had been to increase the acreage planted only to 29,166,000 against 28,024,000 in the previous year, and with unfavourable weather in the early months of the season it was not expected that this would produce more than eleven million bales. But in July the weather took a turn for the better, and the first crop forecast as at August 1 gave the surprisingly large figure of 11,798,000 bales. It may be recalled, however, that this figure was gradually whittled down in every subsequent report until in December it was reduced to 10,734,000 bales.

In the meantime, the Government had had to announce their loan policy for the 1935 crop, and they did so in August, while the market was still suffering from the disappointment over the big crop figure. Omitting certain detailed points on which the Government were forced to amend the scheme as first announced, what it finally amounted to was a loan of only 10 cents against 12 cents the previous year, but with the addition of a new scheme of bonus payments to the grower based on the average price for Middling in the ten designated spot markets throughout the Belt, so that whatever price he actually received for his cotton would be made up to 12 cents by the Government (subject to a limit of the bonus to 2 cents). The idea apparently was to make the loan so unattractive that the planters would not take advantage of it. On the contrary, the proposed benefit payments would be an additional attraction to the growers to let their cotton go; and this plan proved, on the whole, successful, for so far this season the crop has moved much more freely into commercial channels, and the amount pledged to the Government under the loan has been very small.

In November the Government announced their area restriction scheme for 1936, which was on similar lines to those of the two previous seasons, but with some modifications. The whole scheme of

acreage restriction had been based throughout on what was known as the "basic acreage" of the five years 1928-1932, and this had worked out at a figure of 41,436,000 planted; but it now appeared that the basic acreage in 1935 had been raised to 45,500,000 acres, and for 1936 it was to be reduced to 44,500,000. The reduction on this figure was to be at a minimum rate of 30 per cent. and a maximum of 45 per cent. In order to focus this whole business of acreage restriction we give here a table showing the actual figures in 1933, 1934 and 1935, and the intentions for 1936:

(000's OMITTED.)

	<i>Basic Acreage.</i>	<i>Reduction Per Cent.</i>	<i>Nett.</i>	<i>Actual Acreage Planted (First Estimate).</i>	<i>Acreage Harvested (Final Figures).</i>	<i>Crop.</i>
1933 ...	—	—	—	40,798	29,978*	13,047
1934 ...	41,436	40	24,862	28,024	26,987	9,637
1935 ...	41,436	{ 25 35	{ 31,077 26,933	29,166	27,331†	10,734†
1936 ...	44,500	{ 30 45	{ 31,150 24,475	—	—	—

* Less 10,396,000 acres Special Abandonment.

† December estimates.

It remains to describe the effect on the market of the Government's holding of six million bales, which, it must be remembered, was not affected by the Supreme Court's decision against the A.A.A., because all these loans had been made by a special body set up for the purpose, the Commodity Credit Corporation operating with funds from the Reconstruction Finance Corporation. This was divided roughly into one and a half million bales, still remaining in what is called the "Pool" from the 1929 to 1933 crops, and four and a half millions out of the 1934 crop under the 12 cent loan, which had been extended to February 1, 1936. Before that date the Government had from time to time released considerable quantities of the Pool cotton, but as February approached strong pressure was exercised on them to extend the 1934 loan period for at least another six months.

During the early autumn months of 1935, however, the statistical position began to improve greatly. Exports from America showed a marked increase on those of the previous season, and the world's consumption of American cotton was also showing much better figures.† This led to the growth of the feeling that the Government

† See figures given in our usual statistical article, p. 125.

might now supplement the freer marketing policy in regard to the 1935 crop by some scheme of putting the whole of their six million bales into market channels, though, of course, it was realized that this could only be done gradually over a period of years. For this purpose it was suggested that the Government, instead of extending the 12 cent loan, should immediately take over the whole of that four and a half million bales, though it was obvious that with prices now a little under 12 cents for Middling, their doing so would involve them in the loss of the whole of the carrying charges on the cotton, which by now had probably brought the average cost of the cotton to the Government up to about 13 cents.

Faced with this problem, the Government delayed their decision till the very last minute, and finally announced on January 31 a plan which was neither one thing nor another—namely, that “the cotton loans will be carried as ‘past due,’ and an effort will be made to work out arrangements so that some of the loan cotton can be marketed. It is generally thought that the market will absorb a substantial amount of this cotton within the next twelve months without adversely affecting market conditions, possibly as much as 500,000 to 750,000 bales, provided it is only made available to meet current demand.”

This was not unduly optimistic because the steady reduction of the crop estimates and the rapid movement of the crop into trade channels had by this time produced virtually a Government corner in the market. The trade was needing to draw on the Government's holdings, and the Government were only too willing to let the Pool cotton go, but the question was at what price. Earlier in the season the Government had been anxious to get the market back to its normal condition, under which there is a premium on the distant months as compared with the nears, and in this they at first had some success; but as the autumn drew on and the spot position became acute, the Government found themselves, willy-nilly, acting in a way which produced the directly opposite result. The Pool held a considerable quantity of futures in various months, December, January, March, etc., and as each of these months approached, the market found itself completely in the hands of the Government, because there was very little spot cotton available for tender against these futures, and they therefore had to buy them back from the Government at whatever price the Pool chose to fix. The result was that the futures prices of December, 1935, and January, 1936, in turn were forced up to near the 12 cents level, while new crop months remained much lower, so that at one time October went to a discount of 180 points below January.

The result of this extraordinary position was the introduction in the Senate of the Smith Bill to compel the Government to sell 20,000 to 25,000 bales of cotton every week, which it will be noted would mean that it would take nearly six years to get rid of the whole of the Government's holdings. The Government authorities, however, strongly resisted this measure, as they wished to have a greater discretion in the fixing of their sales, and, as a matter of fact, in some recent weeks it is said that they have sold as much as 50,000 to 100,000 bales. In February, therefore, that Bill was still under discussion in Congress.*

In the meantime the administration had been struggling with the consequences of the Supreme Court's decision against the A.A.A. There were three questions involved: (1) What was to be done about the processing taxes already paid? (2) How were new funds to be found for the continuance of the payments for area restriction? And (3) What statutory authority could be devised for the system of crop restriction which would comply with the Supreme Court's decision? As to the first of these points the position is still obscure, largely because it involves the question whether the processing taxes had been passed on by the manufacturers who paid them in the first place to the consumers in higher prices. In view of this uncertainty many of the manufacturers hesitated to pass on the full relief of the 4-2 cents per lb. to their customers in lower prices, with the result that the abolition of the tax has not yet had the expected effect in producing increased consumption. The delay in deciding on the second point unfortunately produced a similar result because one of the proposals for finding new funds was an excise tax on cotton manufactures, and it was proposed that this should be retroactive to the beginning of the American financial year, which is June 1.

But the third point has so far proved the most difficult of all. After much searching the authorities discovered that a Soil Conservation Act passed in 1935 seemed to provide, with some modifications, the skeleton of a system for restriction of the area under major crops, and a Bill was introduced in Congress for this purpose. The Bill, however, had a rough passage, largely on the ground that it was no more likely to pass the Supreme Court than the original legislation. It had, therefore, to be modified in some way, of which details have not yet reached this country, so as to make its enforcement dependent on the co-operation of each state, and it passed both Houses of Congress during February.

* Senator Smith has since extended the range of his sales limits to 10,000-40,000 bales per week, and this may lead to a compromise.

The idea of the new Bill seems to be to induce the planters to restrict the area under major crops indirectly by paying them to make other uses of their land. The main practical point, of course, is whether this new scheme can be put into effect in time to affect this year's acreage, and one point in its favour is that it requires no elaborate organized drive for signing up contracts as the old scheme did; but that, on the other hand, means that it will not be possible to estimate from the number of contracts signed how far the scheme is likely to be successful. We shall therefore simply have to wait again till July 8 for the Government's first estimate of the acreage this year, but already private reports are appearing which indicate the probability of an acreage round about thirty-three millions. What crop such an acreage may yield is, of course, largely a matter of the weather, and it is only necessary to point out that during the last ten years the yield per acre has varied between 157 lb. and 211·5 lb. Allowing, therefore, for the ten years' average abandonment, an area of thirty-three millions planted might give a crop of anything from 10,593,000 to 14,270,000 bales.

It only remains to add under the last heading of our summary—Inflation—a brief reference to the Government's Silver Purchase policy. The pivot of that system is the price which the Government pays for silver mined in America. The prices they pay abroad are never published, but presumably they bear a certain relation to the price of the domestic mined product. In April, 1935, they raised the domestic price (twice in one month) to 77·57 cents, and this raised the London price—which is practically the world price—to 86·25d., as against the low record of 12·00d. in 1931. This, however, had the most disturbing effect in every other country in the world where silver is either produced or used as coinage. Mexico immediately had to resort to a temporary paper currency, and China, which had in effect gone off the silver standard in October, 1934, finally decided in August, 1935, to replace her silver currency with paper and throw her stocks of silver on the world's market. For a time America continued to buy, at of course rapidly diminishing world prices, until in December they suddenly decided that the position had become intolerable and stopped buying in London. The result, of course, was that silver declined again (to 19·00d.), though it is understood that the U.S. Government are still purchasing, but where and how much and at what price is not known. The representatives of the silver states in Congress are, of course, very much upset, but so far they have apparently not been able to compel Roosevelt to do anything about it.

His refusal may be partly attributable to indications from other directions of the danger of inflation. The Veterans' Bonus Bill—under which immediate payments will fall to be made, mostly in currency, to the extent of about two thousand million dollars—was at last passed over the President's veto in January, 1936, and the immediate effect was a heavy fall in the dollar, which carried it below \$5.03. There has also been a considerable revival of the old agitation to get the President to carry his powers of devaluation of the dollar to the full extent of 50 per cent., but so far he has resisted all such pressure.

It appears, therefore, that on all but one of the four heads of the summary with which we started this article the position in America is still obscure. The Bankhead Act is gone, but the other three problems, area restriction, Government loans and Government holdings, and inflation are still very much to the fore.

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COTTON ROTATIONS

BY

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No one who reads the reports of the various agricultural experiment stations that are at work in the tropics can fail to notice the increased attention that is now being paid to questions of rotations, whether for cotton or for other crops. This phase is a logical development, following on our steadily increasing knowledge of crops and agricultural conditions in the tropics. One aspect of it, rotations in which cotton is included, may be of interest to readers of this Journal.

Now the varieties of cotton are so numerous, and they are grown under such diversity of conditions both climatic and cultural, that almost every tropical crop is, or may be considered, a crop suitable for cultivation in rotation with them, and an article on rotation crops for cotton could be made to degenerate into a kind of catalogue. It is proposed, therefore, in this article, to deal mainly with the Upland American crop, the one in which the readers of the Review are most interested, when grown in the conditions in which the Empire Cotton Growing Corporation is mostly working.

The object of the Empire Cotton Growing Corporation is the development of cotton production in all parts of the Empire where there are possibilities of its being successful, and it is interesting to see the steps by which this possibility has been studied. The first step obviously is to find out, for any locality, whether cotton will grow at all. This step implies the establishment of experimental stations, at which trained observers try out different kinds of cotton on comparatively small trial plots, designed primarily to obtain quality, as judged by samples which can be submitted to spinning tests, but leading on to an appreciation of the cropping powers of the cottons to be tested. Incidentally, this first step has been simplified and accelerated in recent years by the great improvement effected in the organization for testing small samples. It is not so long ago that nothing under a bale (400 lb.) would be considered for a test; now as little as 10 lb. can be made to serve.

The next stage, when the fact has been established that cotton will grow, and will give satisfactory yields of good quality lint, is to

ascertain just what is the best strain of cotton to recommend. This will imply experimental work of considerably more complexity than was at first attempted, extended moreover to areas beyond the experiment station proper. Yield trials, where both quantity and quality have to be taken into consideration, are not easy to conduct or interpret, and it may be some years before a decision can be reached. Even then the decision will not be final, for the process is really a continuous one. In a recent article¹ Dr. Balls shows how, in Egypt, there is a continuous production of new strains, to take the place of former favourites which pass into oblivion.

But there is yet a third stage. Even when a cotton has been shown by trials to be really satisfactory and superior to all others, there remains this question, *How best can it be grown?* and this immediately raises a variety of new problems, agricultural as well as other. Of the former, one of the most important concerns the question of the most suitable rotation in which it can find a place, and the difficulty of finding an answer to this question, and the many aspects from which it must be regarded, are the excuse for this article.

It may be, of course, in some areas, that the answer to the question will be in the negative—that cotton is best grown not as a rotation crop at all, but simply for one or two years on land which is cleared for this crop and abandoned when the crop has been taken. It is true that this may be regarded as a kind of rotation of cotton (x years) followed by fallow (y years), after which cotton is grown again, but it is an example of what is known as “shifting cultivation,” a practice which has come under the ban of most Colonial Governments, acting through their Forestry and Agricultural Departments. The objection to it is that it is wasteful, but it is sometimes overlooked that the waste is of materials which would not otherwise be utilized at all. Indeed, the practice is economical in the way that it deals with weeds, for the weeds of cultivation—*Cynodon dactylon*, *Saccharum spontaneum*, *Cyperus* spp., *Imperata*—cannot survive the competition of fallow vegetation, and are killed. Further, the burning that often accompanies the clearing is a ready and cheap means of making available the stores of potash and phosphoric acid that have been built up into the vegetation.

There may thus be little objection to a system of shifting cultivation, *provided there is plenty of room*, and provided consequently that a sufficient interval elapses between successive clearings. But it marks a comparatively low standard of agriculture, and must in time be displaced by a more settled system, such as the “mixed farming” which is now being so strongly advocated by the Depart-

ment of Agriculture in Nigeria.² It is particularly undesirable in the case of cotton cultivation, because it is bound to encourage both the ratooning and the abandonment of cotton, two practices fraught with considerable risk.

In any consideration of cotton growing, wherever it may be, it is not long before this vexed question of ratooning comes up. In the past, the matter was judged out of hand, and there was no dallying with it. Ratoon cotton was poor in quality and tended to increase the many insect pests from which cotton suffered, and ratoon cotton must go. Recently there have been dissentient opinions, summed up by Templeton,³ who claims that a ratoon crop is earlier and better than a plant crop, and suffers less damage from insect pests. Since then the battle has been joined, and evidence produced to back both sides. Now it has always been known that a ratoon crop, ratooned at the right time and treated in the right way, was a sound proposition, though there will always be the increased cost of picking, which puts it out of consideration in countries where picking costs are high as in Queensland. But, and the but is a large one, the trouble lies in conditions that are accentuated by the ratoon crop, and there is always the risk that ratoon cotton will degenerate into stand-over cotton, or be abandoned—in either case affording opportunities for the multiplication of insect pests. So let us have no paltering with the problem, no listening to vague suggestions about trap-cropping or taking advantage of full stands, and let us insist that all cotton of Upland type be cleared at the end of a single crop.

If cotton is to be limited to a single crop at a time in any settled system of agriculture, it must be grown by itself alternating with one or more fallows, or it must be grown in rotation with other crops. The former practice is sometimes adopted with the idea of conserving moisture, that is of storing up the moisture received during the period of fallow and carrying it over to become available for the needs of the cotton crop. This moisture question is an acute one in parts of South Africa, and it is here that we find this practice under careful trial. It sounds quite a feasible undertaking; but experience at Barberton has shown that cotton after a fallow may start off well, but subsequently tends to slow down, especially in the mid-stages of the crop's growth, and is inferior to cotton grown after a rotation crop like beans, maize, or sunflowers. The problem has not been completely solved, but it is suggested that the depressing effect is due to the greater aeration brought about by the development of the roots of the intermediate crops. When the roots of the "fallow"

cotton reach the zone of unaerated soil their growth is checked. Towards the end the "fallow" crop may show considerable improvement. Experience in Queensland has shown a slight but non-significant increase in cotton grown after a fallow over a term of years.

Actually, attempts have been made to evolve a system of continuous cotton growing along these lines, that is of cotton and fallow in alternate years. The maintenance of fertility offers no difficulty, because the cotton seed can be returned to the land either directly, as manure, or indirectly, by feeding it to animals pasturing on the land. It was along such lines as these that the large cotton-growing companies in Portuguese East Africa and South Africa were organized.

In most cases, however, it will be more economical to grow cotton in rotation with other crops, and it is not always an easy matter to decide not only what crops should be grown, but also the order in which they should be taken. Cotton is a tropical crop; it requires plenty of heat during the period of growth, and it must ripen into a dry period. Williams⁴ indicates the three types of climate in which cotton is grown: in a warm period between two periods of low temperature, as in Mesopotamia and South Africa; in a cool period between two warm periods, as in the Sudan; or thirdly, in a more or less constant temperature, such as Nigeria or Uganda. Obviously these types of climate must be borne in mind when considering what crops would be suitable to grow in rotation with cotton.

There are many other points to be considered. If cotton is being introduced as a new crop for the first time, it is probable that the area already grows food crops, and it is quite likely that these are grown in some kind of more or less defined rotation. There are two alternatives—either to try to introduce cotton into such an already existing rotation, or to devise an entirely new rotation embodying the new crop, cotton, and possibly other novelties along with it. Where the introduction of cotton marks not only a new crop but the first crop which the peasant has ever grown as a money crop, the second alternative has much to commend it. The fact that he, a mature and experienced farmer, is growing a crop of which he has never heard, and that this crop is going to be exchanged for money at a Government auction instead of being grown for his own use, embodies two such new ideas to the peasant that it places cotton growing rather in a category by itself. Cotton worked into an already existing rotation will, as likely as not, be regarded as a subsidiary crop; cotton forming the basis of a new rotation will almost certainly be the main crop to be considered.

When so many points have to be weighed, and so many problems of yield and quality kept in view, it is not surprising to find that the grower is not always considered capable of deciding for himself what crops he shall grow along with his cotton, and that the decision is taken out of his hands by higher authority. For example, for many years in Tanganyika the grower, whether native or non-native, has been forbidden by ordinance to take more than two cotton crops in succession on the same land. In Egypt control has been exercised, on more than one occasion, by limiting the area which a single grower could put under cotton; but it is under the tripartite system of the Sudan Plantations Syndicate that the strictest control is exemplified. A year or two ago, the Syndicate deliberately altered the rotation that was then being practised, and substituted one in which there was less chance of stand-over cotton plants remaining undiscovered. The reduction in the numbers of such stand-overs implied a consequent reduction in the early infestation of the main crop by white fly, and a lessened attack of leaf-curl. Instead of the cotton crop being followed by *Dolichos lablab* (*lubia*) or *Sorghum* (*dura*), both crops in which it was difficult to spot odd cotton stand-over plants, it was ordained that it be followed by a bare fallow.

Enough has been written to show that there is a great need for careful experimentation to determine: firstly, how often it is safe to grow the cotton crop, that is how many years should elapse before it is grown again on the same land; and, secondly, what should be done with the land in the interval. Unfortunately such rotation experiments are not only most difficult to carry out but take up a considerable area, which may not always be available at an experiment station. It is, for example, desirable that rotations arranged to run for four years should be replicated four times, so that in each season there is one representative of each year of the rotation, for only by such methods is it possible to make allowances for seasonal variations. Plots must be of a fair size, for otherwise the crops will not grow under natural conditions. A good example of such a lay-out is seen in the Barberton Station report for 1932-33.⁵ Here the rotation was only a two-year one and the land was divided into two: one part was planted to cotton, the other with a variety of rotation crops including a fallow. In the following year the treatment of these halves is reversed, and the growth of cotton, after these various treatments, can be compared. Henceforward it will be possible to make this comparison every year and thus, to some extent, obliterate the effect of the season.

It is, in fact, at Barberton that this question of a suitable rotation

has been worked out more fully than elsewhere, for it was early realized that the prospect of cotton being grown at all depended on the discovery of a crop with which it could be rotated. As stated by Parsons⁶ all the crops were tested from the standpoints of soil fertility, seasonal management and pests and diseases, in addition to their revenue value.

It is not possible, in the space of this article, to give many actual rotations. They are, in general, built up on a basis of food or money crops, of restorative or exhausting crops, of deep-rooting or shallow-rooting crops. The simplest will include a food crop, *Sorghum*, where conditions are severe; maize, where conditions of rainfall and fertility are better, and a legume. The rotation suggested for Domira Bay on Lake Nyasa, for instance, is maize, cotton, and pigeon-pea.

Reference has been made above⁷ to the system of mixed farming which is being advocated by the Agricultural Department in Nigeria. In connection with this a rotation has been worked out mainly to solve the question of the most economical use of the rather limited amount of pen-manure which the peasant has at his disposal.⁷ As cotton is included it is worth recording:

1. Maize (or millet): cotton planted through.
2. Part in groundnuts: part in fodder crops (or all in groundnuts).
3. Guinea-corn (or millet and guinea-corn).

As an example of a rotation in which cotton is relegated definitely to a subsidiary position may be quoted one suggested by Fraser in Northern Rhodesia, where tobacco is the important crop, and everything else is subservient to it. Here two crops of tobacco are taken, each manured, followed by a green manure crop, and subsequently maize or cotton.

Even when such experiments are concluded their lessons may only have a local value, for what succeeds in one area may not do so in another. In Tanganyika, Wakefield⁸ emphasizes the value of a deep-rooted crop like pigeon-peas once in five years or so, or even cotton, to break up the "cultivation pan" formed by continual shallow use of a hand-hoe. On the other hand just the reverse is reported from Queensland, where cotton appeared to thrive when planted after any crop that did not possess a deep tap-root.⁹

Lastly, mention must be made of mixtures, which so largely take the place of rotations in peasant agriculture in the tropics.¹⁰ The practice of mixed cropping is apt to be dismissed as poor farming unworthy of serious consideration, especially by those who are

new to it, but there is much to be said for it, and it will hold its own for a long time to come. There is no doubt that it makes a most efficient use of the soil irrespective of the season, and where crops are all harvested by hand there is little objection to it on the ground of expense, while there may be definite advantages. Mazabuka, for instance, reports¹¹: "It is interesting to note in this connection that in the plots used for stainer observations, grown by natives, no damage by *Heliothis* was observed. It may be that the multiplicity of crops grown by the native, with their differing flowering periods, proved more attractive to the moth," so that from this point of view also it possesses advantages. A statement from Nyasaland¹² is equally emphatic: "A close study of native methods at Port Herald has shown that the native's practice of growing millets, cotton and legumes in the same garden is very sound. . . The fundamental idea of mixed cropping is sound."

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RECENT WORK IN PLANT BREEDING

BY

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For some eight thousand years man has been engaged in the breeding of plants for his own use, and during these long centuries of time there has been a steady improvement of all the plants which provide him with material for food, clothing and ornament. Up to thirty-five years ago this improvement was for the most part haphazard and accidental; though in fact intelligent selection of the best and most useful varieties was constantly practised, and any new improvements unexpectedly arising were carefully preserved. Actually the progress achieved by these non-scientific but commonsense methods was extraordinarily good, but owing to a lack of knowledge of the laws of heredity it was of necessity extremely slow and often wasteful in effort and outlay.

In 1900 the finding of Mendel's long-lost paper disclosing his discovery of the fundamental laws of heredity caused a complete revolution in breeding. To their credit plant-breeders were quick to grasp the importance of the new facts in helping them to a more speedy and a surer solution of their problems. In all cultivated plants new work was enthusiastically carried through, old varieties were tested and purified and new varieties were raised which contained a preponderance of desirable qualities. The further discovery that all heritable characters, whether structural or functional, were due to the actions and reactions of the minute living molecules known as genes, situated in the chromosome threads of the nucleus of each cell in every plant and animal (including man), was a still greater cause of progress. It was immediately realized that the best results in breeding could only be obtained by an intensive study of the chromosomes and genes of any plant which was being used. This study revealed many startling facts, and provided a complete explanation of some hitherto quite inexplicable difficulties. It is safe to say that the union of the two new sciences of Cytology and Genetics into one was one of the greatest revolutions ever brought about in biological science and is bound to have the greatest possible influence on the future of man.

After thirty years of concentrated experiments by a great number of research workers with millions of plants and animals in the numerous laboratories and research stations which had sprung up all over the world, it was realized that in many cases the limit of improvement had been reached. The existing varieties had been bred to such an extent that their possibilities were more or less exhausted, their desirable genes had all been utilized and all the most desirable combinations had already been attained, though in many cases the ideal had not been fulfilled. Only one thing could give further progress—the introduction of new genes and new methods of combining them with the old genes.

The discovery that new mutations could be produced by X-raying gave a new stimulus to the work. Unfortunately, as in all natural mutations, the great majority of X-ray mutations are pathological or lethal, so that although their incidence is enormously increased the production of new forms of real value by this means involves considerable labour in testing large progenies. Fortunately a new and extremely profitable method arose in the hybridization of widely distinct species and even genera which, by their combination, brought together entirely new gene-complexes of a highly desirable kind. Hitherto the union of different species had brought about little success owing to the sterility of the hybrids. The discovery that a duplication of the entire chromosome set of the hybrid either in the germ cells or in the body cells (Hurst, 1933, 1935) produced fertile germ cells and progeny and created new species and genera, gave new hope to this branch of breeding which has proved to be amply justified. In this connection the use of X-rays is of great value, for one of the most useful results of this treatment is the duplication of chromosome sets. In an ordinary species this is important, although not of vital importance, since it only increases the size of the individual without producing any other desirable genic changes, but in these specific or generic hybrids it is of the utmost value, for it converts a sterile hybrid into a fertile and pure-breeding new species or genus combining the qualities of the two parent species, and containing a new complex of genes which often in their reactions together give rise to new qualities. Above all the new forms possess greater potentialities for mutation in the greater number of genes, and hence afford more hope for the production of new varieties.

Here we come to the real essence of modern plant-breeding. Once the possibilities of interspecific and intergeneric breeding were realized, the introduction of new genes became an all-absorbing problem. The great work of the modern breeder is the search

for new genes, especially those which give resistance to the numerous and devastating diseases which attack crops in every country. Fortunately, it has been discovered that in most genera there are many wild-growing species which are immune to the diseases which attack cultivated plants, and by using these species it is hoped to be able to produce disease-resistant plants which will still contain all the desirable points of our best cultivated varieties together with the addition of other good characters which are not yet present.

Under their able leader Dr. N. I. Vavilov, the Russian plant-breeders have been in the forefront of this new phase of breeding. Expeditions have been sent out to every country in the world to collect all the possible species allied to the plants which constitute our present crops, and also to discover new sources of the various commercial commodities, such as fibres, oils, rubber, etc. In addition to the wild-growing species there are many ancient species and varieties still in cultivation in remote and outlying districts which contain valuable qualities, especially in their adaptation to peculiar and exacting environments. One of the great problems of modern plant-breeding, besides that of disease resistance, is the production of varieties which will give a full yield under adverse conditions. In a country such as Russia, and within our own Empire (under such diverse conditions as exist in Australia or Canada), there is a great need for new varieties and new types of crops fitted to each particular type of locality. It is useless to expect a high-yielding, disease-resistant plant fitted to normal conditions to function adequately in districts subject to drought or to extreme cold; such districts must have their own varieties specially bred for them. For this purpose the old-type crops of the isolated communities are ideal, for they have, through countless generations of natural selection, become adapted to their environment, which in many cases is of a highly specialized character, since they are usually found in out-of-the-way mountain districts or under steppe or desert conditions. In these districts there is a wealth of new genes to be found in every kind of cultivated plant fitted to all possible conditions.

The experimental stations throughout the world are making exhaustive collections of the likely wild-growing species and of the locally cultivated crops, and from the new gene combinations arising from their hybridization with our existing crops great hopes are entertained.

Cotton.—In cottons work has been proceeding steadily all over the world. In attempts to produce cottons suitable for their diverse environmental conditions the Russians have put in an immense amount

of work in studying the genes and chromosomes of varieties and species, and have carried through numbers of hybridizations. At Tashkent, a study was made of ginning percentages by investigating the number and weight of the fibres and weight of seed, and it was found that there was a wide deviation in this respect between different cottons. The number of fibres per seed in seven varieties of American cotton varied from 7.8 to 14.7 thousand, while the weight of a thousand fibres varied from 4.4 mg. to 7.6 mg., and the seed weight from 97.0 to 167.2 mg. In *G. herbaceum* the number of fibres per seed varied from 3.6 to 9.2 thousand, the weight of a thousand fibres from 3.4 mg. to 5.8 mg., and the seed weight from 69.7 to 111.8 mg. Crosses have been made in which it is hoped to combine the higher number of fibres with the heavier weight, and in the second generation of a cross between two lines of *G. herbaceum* some plants arose with the desired combination and showed a ginning percentage of from 7 to 13 per cent. higher than the better parent. In the fourth generation a true breeding line was obtained in which the percentage was 8 per cent. higher than the better parent.

The type of boll in *G. herbaceum* is very variable, but the closed boll proved to be a simple mendelian recessive to the open or semi-open boll, both of which are undesirable in mechanical harvesting. Size of boll was found to be dependent on a number of genes in American cottons, and it was necessary to grow some thousands of F_2 seedlings to obtain the desired types. By crossing with early maturing forms it was also found possible to unite high yield with early maturity. Many other points were studied, and it is pointed out that since a large number of genes are involved in these cottons it is wiser to limit the parental combinations as much as possible in producing new varieties by hybridization, and to grow the largest possible number of progeny. Back-crossing is also useful for reducing the number of segregating types in later generations.

The Transcaucasian Cotton Research Institute have issued a bulletin describing the progress made in the acclimatization of Egyptian Cottons; descriptions, illustrations and lint qualities of selected new lines are given. The varieties have been divided into six groups based on their maturity periods. Another publication from Moscow gives the spinning qualities of a number of the best improved varieties grown in the U.S.S.R. Varieties of the Pima type of Lower Egyptian Cottons have been grown under varying conditions for comparison. Upper Egyptian types, including Ashmouni and allied varieties, Uplands and strains with medium staple, have also been tested. It has been found that by means of

transplantation it is possible to grow high-quality Egyptian varieties in the region of Tashkent, and some selections of Pima can be spun to 120 counts. Longstapled Uplands, however, are superior in yield, and are as good as the Egyptians for spinning 50's and 60's.

The experiments in vernalization of cotton were attended with much success, not only in producing a higher yield under normal conditions, but also, in several cases, in increasing lint length. The seed is moistened and then kept at a temperature of 25° to 30° C. for varying periods. It was found that the best results were obtained after ten to fifteen days' treatment for Navrotskii, fifteen to twenty days for Acala 8517, and fifteen days for the Egyptians; longer periods caused depression of germination and shorter periods had no effect. The chief effect of optimum treatment seems to be a more rapid completion of the various phases of development rather than any particular acceleration of their inception. All the varieties vernalized germinated from two to three days earlier than the controls, but later stages showed considerable variation. In the American cottons treatment produced a tendency to higher ginning percentage and length of lint, but in the Egyptians the ginning percentage was increased while the lint length was slightly decreased. The flowering period was usually from three to four days earlier, but in Navrotskii it was as much as thirteen days, and in Ashmouni nine. The differences in maturity were often greater, varying from four to fifteen days earlier. In all cases the plants treated in the Russian experiments showed an improvement over the controls, and it is probable that this method may be of much value in growing crops in those regions not naturally fitted for them. Certain cases of failure are attributed to imperfection of technique rather than to any deficiency in the treatment, and different varieties gave widely different reactions; in some cases there were even differences within the varieties themselves. It is pointed out that greater knowledge is needed before the best results can be expected. The effect of the treatment was considerably greater in 1933 (which was a very bad season for cotton-growing in the new regions) than in 1934, when the natural conditions were more favourable to normal growth. Vernalized sowings were made on a large scale on collective farms in 1932, 1933 and 1934, with an increase from 600 ha.* to 3,000 ha. under cultivation in the three years. The average yield increase was from 0.3 to 2.5 centner† per ha. but on one farm the yield increase in the treated crops was four times that of the untreated.

At Tashkent experiments were also made on the photoperiodism

* Hectare=2.47 acres.

† Approximately 1 cwt.

(adaptation to length of light-day) of the cotton plant, subjecting different varieties to daily illumination amounting to 6, 9 and 12 hours against the average of 14 hours of the controls growing under normal conditions. Observations showed that cotton is essentially a short-day plant, which complicates its successful growth in long-day regions, since a reduction of illumination causes early maturity. Different varieties, however, show different hereditary reactions corresponding to the position of their original environment with regard to the equator, those from equatorial regions needing the least light and this effect becoming less and less as their place of origin is further removed from the equator. The general effect of the shortened illumination is the production of sympodial branches at a lower level and consequently an earlier production of flowers and bolls. By making the necessary comparative alterations in the daily amount of light it is possible to synchronize the flowering periods of widely divergent varieties and species, and to make crosses hitherto difficult owing to the difference of their flowering seasons in these new regions. Crosses have thus been made between Egyptian cottons with low boll weight and several South American cottons with very large bolls but of short day and perennial habit.

Within our own Empire work on the improvement of cottons is also steadily proceeding, but this is too well known here to need repetition.

Beans.—New varieties of Soya beans have been produced, suitable for conditions on the Ukraine steppes. Those previously grown proved unsuitable for mechanical harvesting owing to the pods occurring too low down on the plants. Of the new strains produced one is equal in yield to the best imported types and is early maturing, while another provides superior fodder. In Uruguay, where the varieties successful elsewhere have proved failures, a collection of 233 varieties from widely different sources and conditions has provided ten promising types. Selected lines of these have given very high yields, and others have been bred which are resistant to drought, which normally has a very adverse effect on germinating qualities, both at harvest and sowing. The best of these new lines have a protein content of 34 to 39 per cent. and oil content of 14 to 20·5 per cent. with a yield up to 1,000 kg. per ha.

This wonder plant, the "staff of life" in the Orient, which provides meal, oil, food for cattle and a fertilizer, has also been successfully introduced into England by careful selection of early maturing varieties and their acclimatization for several years by Mr. J. L. North. The remarkable properties of the Soya bean are not yet

appreciated by the British farmer, and a book on the subject has recently been written by Miss E. Bowdidge to make its cultivation more popular. It is to be hoped that its value may soon be realized and taken advantage of by its widespread cultivation.

Cereals.—Work steadily proceeds all over the world to produce new improved forms capable of cultivation under diverse conditions, and to provide each district with an ideal variety by hybridizing the highly specialized local cultivated forms and species with the high yielding normal types. The new genera formed by generic crosses between wheat and rye, and wheat and *Aegilops* in Russia and Germany have already been described in this Review (Hurst, 1932), but recently an even more interesting line of investigation has been opened up in the hybridization of wheats with the couch-grass *Agropyrum*. This grass is perennial, and it is hoped thus to produce perennial wheats of extreme hardiness for cultivation under adverse conditions. Three species of *Agropyrum* have been successfully used in crosses at Saratov. The first-generation plants are very luxuriant, forming up to 150 heads on one plant. They show a preponderance of *Agropyrum* characters, which is to be expected since *Agropyrum* is a decaploid with 70 chromosomes (10 sets) while *Triticum vulgare* is a hexaploid with 42 chromosomes (6 sets). The hybrids were all perennial and fully resistant to frost, and the first generation of *T. vulgare* crossed with *A. elongatum* is distinguished by excellent fertility, one plant giving as many as 665 grains. Other crosses showed diminishing fertility according to the parentage. In the second generation wide segregation occurred, but the fertility was higher, the grains being large and vitreous. In the third generation many plants showed quite normal fertility, the grain being mainly of the wheat type. Several of the hybrids showed resistance to rust and smut, and freedom from shattering, with the addition of various other valuable characters, and this new breeding work is obviously of great practical importance. It is evident from the results obtained that certain species of couch-grass have a very close affinity with certain wheat species, their distinction apparently lying only in their two extra chromosome sets. Thus *T. vulgare* may be designated A+B+C and *Agropyrum* A+B+C+X+Y, other species of both having variations. Hence it should not be difficult to fix desirable types in future generations, and it is also probable that some fortunate duplications may occur to hasten the process.

The new genus *Secalotriticum* (Rye×Wheat) (or *Triticale*) is already grown on a large scale. The most notable achievement of the Russian grain-breeders however is probably the distribution of

a very large number of improved varieties of the chief grain crops (wheat, barley, oats and rye) especially suited for cultivation in all the main regions of the Soviet Union, including the arid zones. This has been achieved in the north by the production of ultra-early spring wheats and new hardy winter varieties. One of the new early oats is also highly resistant to drought and rust. The hybrid *Avena sativa* × *A. byzantina* exceeded the standard yield by four times, and showed considerable resistance to leaf-rust, and a new rye produced by crossing a local form of Detskoje Selo with Rümker also showed a great increase. Further improvements are still required, however, especially in disease resistance. From a close study of the methods used it may be seen that all the desirable new qualities have been introduced by using local varieties in crossing, since they possess the essential genes for resistance which are needed by the existent varieties.

The Russian world collection of wheats shows that there are four groups of early maturing wheats: (1) Arctic, (2) from continental regions of the subtropics, (3) from mountain regions, (4) from countries of periodic rain such as China and Japan. In other respects however, these wheats are very different: those from the north need little warmth but much light, and those from the south are resistant to heat but need little light. By the requisite crossings early maturing forms can be raised with varying reactions according to the latitude for which they are required.

Great improvements have been carried out in India on wheats and barleys so that they can now compete in quality with any in the world. At Pusa, types resistant to all the three rusts prevalent in India have been produced. In Egypt since 1921, work has been carried out with great success in the improvement of cereal crops by hybridizations between the native forms and imported varieties. In Australia, collections of cereals from all parts of Australia and other countries have been made in order to breed types fitted to all the very varied conditions of the continent. Three or four hundred valuable new lines have already been isolated and are undergoing exhaustive trials. All European countries as well as America are working on the same genetical lines, and the work done in cereals throughout the world is one of the greatest tributes to the success of modern genetics.

X-ray experiments with wheats show that each variety has its own particular reaction. The soft spring wheats give a great variety of mutants, while the *durum* varieties give a larger number of mutants but a limited number of types.

In China, work is being done in the hybridization of cultivated

rice with the wild forms. A valuable new variety with vigorous growth, resistant to cold and to a high percentage of acidity in the soil, has already been produced. In Japan, experiments with X-rays, ultra-violet rays and temperature changes has induced all the known mutants of rice and other new ones, and in some cases mutants ripened 11 days earlier than the parents.

Lupins.—The Kaiser Wilhelm Institute have put on the market new alkaloid-free lupins which will grow on the most unfavourable light soils and produce extraordinary quantities of green fodder. Crosses between bitter and sweet lupins showed that absence of alkaloid is a simple recessive. The Russians have also done very much in the production of alkaloid-free lupins, having made two and a half million analyses in two years. The great advantage of these new lupins is their high yield and protein content and their capacity for growing on sandy soils where other crops cannot be produced. A common bitter lupin has been discovered with 21 per cent. oil content against the usual 4 to 6 per cent., and it is hoped to combine this new feature with the alkaloid freedom. Disease resistance is also being investigated.

Rubber.—The Russians have made expeditions also to discover new rubber plants suitable for cultivation in their temperate regions. Analyses of 1,048 species of 316 genera belonging to 95 families have been made, and rubber was found in 609 species. The best results were obtained within the *Compositæ* family. A plant found in the Caucasus, *Scorzonera tau-saghyz* showed a higher rubber content than any plant known, the rubber being of high quality and easy to extract. Its unusual capacity for regeneration was also a marked peculiarity of this new species.

Tobacco.—In Russia, work is constantly proceeding to combine the hardiness and adaptations of local varieties with the finer flavour of more desirable varieties. Many extremely interesting compound types have been built up containing the chromosome complexes of three species of tobacco. Much segregation occurs, and desirable new types can be fixed in later generations. These synthesized varieties form a valuable reservoir of new and valuable forms, and correspond to the similar experiments in cereals. In America several pure breeding new species and varieties have been built up in this way, by hybridization followed by chromosome duplication or segregation. The use of ultra-violet rays was found to give rise to conditions of greater fertility in the hybrids. Goodspeed and others find that the tobacco plant is a specially good subject for X-ray treatment, and several useful mutants have arisen by this means. In one case fourteen

different types were obtained from a single X-rayed sex cell; seven were pure breeding derivative types, the others are not yet constant.

Much work has also been carried out with such crops as bananas, sugarbeet, cacao, coconuts, coffee, hemp, potatoes and sugar.

In so short a space it is not possible to deal adequately with any one of the many lines of research being pursued, but enough has been mentioned to show how very much alive scientific plant-breeding is all over the world. Just as new genes are being introduced into existent crops, by the utilization of new species and local forms, so other wild species are being tested and tried out to produce new types of crops. Although the Russians have led the world in the exploitation of world resources, yet there are still untapped reservoirs of wild plants in the Soviet Union itself, many of which are promising new sources of rubber, fibres, etc. The great forests of South America are still largely unpenetrated by man, and one may expect vast stores of vegetable wealth to be had there for the seeking. Above all in China there is an unparalleled wealth of species and forms, often extremely localized. The intermingling here of tropical and temperate floras has resulted in the evolution of a vegetation of unequalled richness and variety. Our own plant collectors have shown us to some extent the horticultural treasures which are to be found there, but the great store of economic forms is still scarcely touched. Chinese forms are also generally characterized by a happy immunity from disease, and many cold-resistant forms of fruits, etc., which are at best only half hardy in the case of those now in cultivation, exist in the northern mountains and at higher altitudes in the south. Excessively late or early forms, wide variations of colour, form, size, flavour, yield, etc., promise an almost inexhaustible store of genes for the future. Thus we may look forward to a very considerable improvement in all our economic crops, fruits, vegetables and flowers within the next few years with special adaptations to all the diverse environments of the various continents. The future of plant breeding is indeed bright, and although much labour will be involved it will be more than worth while in the usefulness of the results.

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RAINFALL AND COTTON YIELDS IN THE SUDAN GEZIRA

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EACH of the four 1935 numbers of this Review contained references to the effects of rainfall on the yield of cotton in the Sudan Gezira, and it is therefore appropriate that some summary should be given here of the results of a detailed statistical analysis on this question recently published elsewhere¹ by E. M. Crowther and F. Crowther. Interest in the subject has been aroused by the fact that in four of the last six years the Gezira yields were low. Some critics of the scheme of irrigation and management see in this evidence of soil deterioration through irrigation without drainage, whilst others point to the high yields of 1931-32 and 1934-35, and similar earlier fluctuations, as evidence of the importance of purely seasonal factors. Reference should be made to other recent articles in this Review for descriptions of the Sudan Gezira and the method of cultivating the cotton. Here it will be sufficient to remind those who are unfamiliar with the area that over most of the period considered (1911-31) cotton was grown in three-course rotation (cotton, food crop or fallow, fallow) and was generally sown in August, during the rainy season, and irrigated at fortnightly intervals from the end of September to March.

RAINFALL IN THE GEZIRA.

Daily rainfall records have been taken since 1906 at nine stations in the Gezira area: one at Khartoum, five along the Blue Nile up to Sennar, two on the White Nile and one in the middle of the Gezira. Recently many additional gauges have been installed throughout the irrigated area, but long runs of data are available only for the three oldest centres, Taiyiba, Barakat, and the Gezira Research Farm. As will be seen later from Table 2, the annual rainfall varies greatly from season to season. For the average of five stations in or near the present irrigated area, over the 28 years 1906-33, the annual rainfall ranged from 184 mm. in 1926 to 500 mm. in 1929, with a mean of 302 mm. (about 12 inches) and a standard deviation of a season's rainfall of 71 mm. This standard deviation may be taken to imply

that in a long run of years the rainfall would fall within the range of 302 ± 71 mm. in about two-thirds of the years, and would fall below 231 mm. in one-sixth and above 373 in one-sixth of the years. Although most of the rain falls in heavy storms, which give the impression of being purely local and irregular, the variations from centre to centre are not sufficient to mask the general character of the season as a whole. Thus the standard deviation of the annual rainfall is 101 mm. for one station as compared with 71 mm. for the average of the nine. Local rainfall data must, of course, be used where possible in analysing the effects on yield.

TABLE I.

GEZIRA RAINFALLS IN MILLIMETRES: MEANS FOR NINE STATIONS, 1906-33.

April	...	...	...	...	...	...	2
May	...	...	...	...	...	...	9
June	...	...	...	...	...	...	26
July	...	...	...	...	...	...	92
August	...	...	...	...	...	...	118
September	...	...	...	...	...	...	47
October	...	...	...	...	...	...	8
Total	...	...	...	...	...	...	302

	<i>Mean.</i>	<i>Standard Deviation for One Station.</i>	<i>Increase per Degree.</i>	
			<i>Latitude.</i>	<i>Longitude.</i>
Early (before July 1) ...	36	28	- 22	22
Middle (July and August) ...	210	85	- 58	50
Late (after August 31) ...	55	40	- 26	16
Total	302	101	- 106	90

The average distribution of rainfall throughout the year is given in Table I. for months, and also for a convenient grouping into early, middle, and late rainfall, which was used for comparisons with yields. About two-thirds of the annual rainfall occurs in July and August, appreciable amounts often fall in June and September, and there may be occasional light showers in April and May, or in October and November. The early rains (before July) and the late rains (after August) are more variable relative to their means than the main or middle rains (July and August). Thus, the average early rainfall for the nine centres falls below 8 mm. or exceeds 64 mm. each in about one year in six.

The average rainfall increases regularly towards the south-east, in the direction of the Abyssinian Highlands, and falls to almost negligible amounts to the north-west of Khartoum. This change

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with position is also relatively greater for early and late rain than for middle or total rainfall. Just beyond the north of the irrigated area Khartoum has 11 mm. early and 160 mm. total rain, while at the southern limit, near the dam, the early rainfall is 82 mm. and the total 456 mm.

TABLE II.

ANNUAL RAINFALLS IN MILLIMETRES: MEANS OF FIVE STATIONS.

$n=$	0	1	2	3	<i>Means of Every Seventh Year.</i>	
	1906 to 1912.	1913 to 1919.	1920 to 1926.	1927 to 1933.	<i>Actual.</i>	<i>Calculated.</i>
1906+7n	268	217	409	367	315	281
1907+7n	271	342	302	230	286	335
1908+7n	350	317	404	500	393	378
1909+7n	472	349	440	361	406	378
1910+7n	341	335	300	253	307	334
1911+7n	242	258	220	402	280	280
1912+7n	232	236	184	376	257	256
Mean of 7 years	311	293	323	356		

In Table II. the average annual rainfalls for the five rain gauges nearest to the irrigated cotton area, are set out for each of the years from 1906 to 1933, arranged in four groups of seven years. The seven-year means show that the period 1927-33 had a higher average rainfall than any of the three preceding groups of seven years, and that, in addition, there is some suggestion of a slight progressive increase in rainfall over the last three groups, which cover the period of irrigated cotton. The rainfall records at the original trial centre—Taiyiba—show that over the period analysed, 1911-31, the progressive increase in total rainfall was sufficiently consistent to be regarded as statistically significant. During the same period the increase at Sennar was also significant. In so far as extra rainfall is harmful, it is therefore necessary to conclude that at Taiyiba the weather has deteriorated during the period in which irrigated cotton has been grown. This fact must be considered before ascribing the decline in yield at Taiyiba to soil deterioration through irrigation. It must also be remembered that there is no reason to expect the progressive increase in rainfall to continue, or to ascribe it to the effects of the dam and irrigation. The records do not go back sufficiently far for an examination of long-term periodicities, but Table II. shows that there is some evidence of a seven-year periodicity. Averaging the rainfalls for every seventh year, there is a minimum for the group 1912, 1919, 1926, 1933, with maxima for the groups

three or four years earlier. A seven-year periodicity with 126 mm. between maximum and minimum agrees sufficiently closely with the actual records to be regarded as significant. It is interesting in this connection to note that in the years 1913-14, 1918-19, 1925-26, and 1933-34, which are close to the calculated minima, special Government measures were needed to meet the shortage of rain-grown dura in the Sudan. Should these remarks recall Pharaoh's dream, it may be pointed out that seven lean and seven fat years make up a fourteen-year and not a seven-year periodicity. Also, it must be noted that seven years is not a very respectable meteorological period, and that past experience gives very little encouragement to those who try to forecast from such slender evidence. None the less, the grouping in Table II. suggests that the sequences of early promise shortly to be followed by disappointments and difficulties leading to new rotations and methods of cultivation, which were experienced first at Taiyiba from 1911 and then again 14 years later when the dam came into use, may have been due, in part, to the chance circumstance that both of these developments took place at periods of rainfall minima.

COTTON YIELDS.

In earlier summaries and discussions of the cotton yields of individual farms in the Gezira, no notice was taken of their irregular expansions, which allowed the introduction of considerable effects through differences in soil fertility. For our analyses we therefore took the special precaution of building up the yields of each area from the records of the individual tenancies (10 feddans or acres) on the commercial land. Thus, at Taiyiba we used the total area until by 1917 it reached a total of 6,000 feddans (one third cotton annually), and ignored all subsequent additions to the farm. Separate analyses were made to give, first, the whole period, and, second, a shorter period for a constant area and a substantially uniform system of cropping. In addition, we found a particularly uniformly treated area of 1,440 feddans, which was brought into cultivation at Taiyiba in 1917, and cropped in three-course rotation until 1931, *i.e.* with five cotton crops on every third of each of its forty-eight tenancies. Similar groupings were made where possible at Barakat, and several independent sets of plots were examined at the Gezira Research Farm. Here it will be sufficient to illustrate our findings by the totals of each of the three farms for the full term, and by the 480 feddans annually at Taiyiba. The actual annual yields for each of these areas are given in Table III.

TABLE III.

COTTON YIELDS IN KANTARS PER FEDDAN, ACTUAL AND CALCULATED FROM REGRESSION EQUATIONS.

Year of Sowing.	Old Taiyiba.		Old Taiyiba (480 Fed.)		Old Barakat.		Gezira Research Farm	
	Actual.	Calculated.	Actual	Calculated.	Actual.	Calculated.	Actual.	Calculated.
1911 ...	5.3	5.2	—	—	—	—	—	—
1912 ...	5.6	5.8	—	—	—	—	—	—
1913 ...	3.8	5.1	—	—	—	—	—	—
1914 ...	5.1	4.4	—	—	5.4	4.8	—	—
1915 ...	3.1	3.5	—	—	3.5	3.8	—	—
1916 ...	3.5	3.4	—	—	3.2	3.2	—	—
1917 ...	4.1	3.6	5.2	4.8	2.7	2.8	—	—
1918 ...	4.1	4.7	5.4	6.0	3.5	3.6	—	—
1919 ...	5.6	4.9	6.7	6.4	5.0	4.5	3.2	3.4
1920 ...	3.2	3.4	3.6	4.4	3.5	3.1	2.6	2.8
1921 ...	3.5	3.7	4.0	4.4	3.9	4.6	3.0	3.0
1922 ...	4.4	3.2	5.2	3.8	4.1	3.9	3.4	3.5
1923 ...	2.6	2.4	2.6	2.6	3.0	3.1	3.2	2.9
1924 ...	2.3	2.8	2.5	2.9	2.3	3.0	1.8	1.8
1925 ...	4.3	3.3	5.1	3.7	3.9	3.3	2.4	2.4
1926 ...	4.1	4.2	4.2	4.9	3.4	4.1	3.9	3.5
1927 ...	2.5	2.8	2.6	3.0	2.9	3.2	3.0	2.8
1928 ...	3.7	3.3	3.6	3.4	4.0	3.7	3.1	3.5
1929 ...	1.4	1.8	1.8	2.0	1.8	2.0	2.0	2.2
1930 ...	1.3	2.2	1.2	1.5	1.5	1.2	1.8	1.9
1931 ...	3.8	3.8	4.1	3.8	3.9	3.4	3.1	3.0

THE METHOD OF ANALYSIS.

In looking for relationships between crop yields and seasonal weather factors, it is advisable to avoid the bias which might be introduced by picking for each set of yield data the particular climatic variables which were found by trial and error to give promising results. In short runs of data some correlations would be expected merely by chance, provided sufficiently numerous and lucky shots were made. Selecting special combinations of variables for separate sets of data may be as dangerous as being content with ascribing one low yield to black arm, another to leaf curl, another to flooding, and so on. A single grouping of rainfalls into early, middle, late and the previous year's total was therefore used for all data. The method of analysing and expressing the results may be illustrated in Table IV. by an early stage which gives the average change in yield per annum or per unit rainfall at each period. The values tabulated may be regarded as giving the slopes of the lines of best fit when the yield for each year is plotted against the rainfall at any period or the number of the year. Asterisks denote the degree of reliability or

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significance, the odds against the effect being due merely to chance being 19 : 1 for *, 49 : 1 for ** and 99 : 1 for ***. Coefficients without asterisks must be regarded as uncertain.

TABLE IV.

MEAN YIELDS AND AVERAGE CHANGE IN YIELD PER ANNUM AND PER DECIMETRE OF ADDITIONAL RAIN: ALL YIELDS IN KANTARS PER FEDDAN (K/f).

	<i>Old Taiyiba.</i>	<i>Old Taiyiba</i> (480 Fed.)	<i>Old Barakat.</i>	<i>Gezira</i> <i>Research</i> <i>Farm</i> (Total).
Period	1911-31	1917-31	1914-31	1919-21
Mean Yield, kantars per feddan	3.69	3.85	3.41	2.82
Standard Deviation of one season's yield	1.20	1.51	0.98	0.63
Mean annual change in yield...	-0.12***	-0.20**	-0.08*	-0.04
<i>Change in yield K/f per 1 dm.¹ rain :</i>				
Early rain	-1.3*	-1.1	-1.7***	-1.8***
Middle rain	-0.6*	-0.6	-0.3	-0.7
Late rain	-1.1	-0.9	-1.0	-0.5
Previous year's rain ...	-0.6***	-0.8**	-0.3	-0.2

At Taiyiba and Barakat the progressive decline in yield is clearly significant. Over the whole period at Taiyiba the decline was at the rate of 0.12 kantars per feddan per annum, or 0.36 kantars per feddan per cotton crop, or from 4.9 kantars per feddan to 2.5 kantars per feddan in the full period of 21 years.

Rainfall effects are given throughout as kantars of cotton per feddan per decimetre of additional rain. For each centre and each rainfall grouping, additional rainfall was associated with lower yields, the effects being highly significant for early rainfall at Old Barakat and the Research Farm, and for the previous year's rain at Taiyiba.

These simple tests are not, however, satisfactory, for the variables are not themselves independent. Thus, we know that the total rainfall increased throughout the period at Taiyiba. If the yields were falling steadily through soil deterioration, this would appear as a correlation between falling yields and increasing rainfall. On the other hand, variations due to one factor may mask those which might properly be ascribed to some other factor. It is necessary to allow for all of these possible cross-correlations before estimating the separate effects. The best simple expression for the independent effects of each of the five separate factors, after eliminating effects due

¹ 1 decimetre=10 centimetres=4 inches roughly.

to the other four, is obtained by calculating the equation of best fit for the yield expressed as a function of the five variables. Such equations are given in Table V., and the yields calculated from these equations and the rainfalls for each year are compared in Table III. with the actual yields to which the equations were fitted. The equations account for a considerable proportion of the total fluctuations in yield, but they cannot be expected to provide very accurate forecasts for any individual year.

TABLE V.

Equations of best fit for yields (y) in kantars per feddan in relation to:

e =early rain in dm.

m =middle rain in dm.

l =late rain in dm.

p =previous year's rain in dm.

t =number of the year from the beginning of the period.

<i>Centre.</i>	<i>Period.</i>						
Old Taiyiba	1911-31	$y=7.42 - 1.16e^{***} - 0.42m^* - 0.87l^* - 0.36p^* - 0.010t$					
Old Taiyiba (480 fed.)	1917-31	$y=9.23 - 1.29e^{**} - 0.43m - 1.09l - 0.64p^{**} - 0.078t$					
Old Barakat	1914-31	$y=6.10 - 2.20e^{***} + 0.07m - 1.10l^{**} + 0.01p - 0.093t^{***}$					
Gezira Res. Farm	1919-31	$y=4.47 - 2.07e^{***} + 0.16m - 1.32l^{***} - 0.08p + 0.006t$					

DETERIORATION AND RAINFALL EFFECTS.

After eliminating rainfall effects, progressive deterioration remains significant at Barakat but not at Taiyiba. In other words, the important result emerges that the progressive increase in rainfall at Taiyiba from 1911 to 1931 is in itself sufficient to account for the progressive fall in yield. On the special area of 1,440 acres over a shorter period the deterioration, though appreciable, fails to reach the level required to establish significance.

For each of the four centres, the depression from additional early rain was highly significant. Extra late rain was generally harmful. Increase in the middle rains or the previous year's rains reduced the yield at Taiyiba, but not at the other two centres.

Although the average effect of 100 mm. of rain was much more serious for early or late rain than for July and August rain, it must be remembered that the fluctuations in early or late rain are confined to a much narrower range than those for middle rains. In order to estimate the order of yield differences which may be expected from normal rainfall fluctuations, we may assume rainfall effects equal to those on the 480 feddans annually at Taiyiba and adjust them for the standard deviation of a season's rainfall. Then fluctuations in rainfall within a range which would include two-thirds of the seasons would produce changes of the order of 0.5 kantars per feddan for each

of the four rainfall periods considered. On this basis, the early rainfall no longer stands out through the magnitude of its effect, but it remains the only factor, meteorological or otherwise, which has been successfully related to the whole run of years for each area tested.

The fact that extra rainfall at any time tends to depress yields should account in part for the continued success of the Northern Gezira area in spite of its admittedly poorer soils. The extreme north of the irrigated area has only about half the total rainfall of the south, and has much less than half of the early and late rainfall.

THE MECHANISMS OF THE RAINFALL EFFECTS.

Heavy mid-season rains delay sowing, damage young plants and encourage weeds at a critical period. Heavy rain in the preceding year also increases weeds, and leaves more weed seeds and straw-like residues. These obvious effects are reflected at Taiyiba, but not at the other two centres. The suggestions were offered that the land at Taiyiba suffered more because it was more frequently cropped, in the early years with extra cotton and later with dura or lubia, and also perhaps because flood water is less easily drained off since the land between the farm and the river is higher here than at Barakat.

Late rains were particularly harmful at the Gezira Research Farm on continuous cotton plots and on miscellaneous experimental plots which included replicated experiments on varieties and dates of sowing. These observations are in harmony with the view that the splashes of rain spread the bacteria responsible for the secondary infection of blackarm, which, in addition, develops rapidly in the plant tissues only under the humid conditions associated with actual rainfall.

There is no such obvious explanation for the unexpected importance of the rain which falls two months before the cotton is sown. E.M. Crowther suggested in 1925 that the first rains restarted the whole chain of biochemical processes suspended during the intense drying of the fallow, and postulated that in some way this led to greater loss of available nitrogen by the time the cotton crop most needed it. F. Crowther, in 1933, suggested that early rains closed off the deeper subsoil cracks and thus still further restricted the available root range. Several alternative suggestions have been offered, but none of the hypotheses has yet been substantiated. At the moment it is scarcely possible to say anything more definite than that early rains interrupt the fallow, and that the effects of fallowing must be more clearly understood before the effects of the early rains can be explained.

CHANGES IN RAINFALL EFFECTS WITH TIME.

The effects of rainfall so far discussed are averaged over the whole of the periods considered, and in the detailed paper it was pointed out that the terms were too short for separate analyses of the earlier and the later years. In introducing our discussion, we added parenthetically that "it is interesting to notice that the correlation between yields and early rainfall appears to have been even closer since 1925 than in the earlier years from which it was first detected." This sentence, which was phrased loosely in terms of correlation, was intended merely as a reminder that the effects considered were not due primarily to a few outstanding early years. It had no bearing on the actual analyses of the average effects published in the paper. Unfortunately this sentence has been misunderstood and given quite unwarranted significance by Dr. W. L. Balls, who recently quoted² it, and added that "it provides the scientific justification for my attitude, neatly confirming my view as expressed in my reply to Dr. Greene and Mr. Bailey." As the possible change of the rainfall effects with time has thus been raised, we have extended our analysis to ascertain for the early, middle+late, and previous year's rain at Taiyiba, and for the early and late rain at the Gezira Research Farm, the effects of introducing additional variables to cover possible changes of the regression coefficients with time. There was no definitely significant evidence that the rainfall effects underwent progressive changes with time, and it is not justifiable, therefore, to conclude that the effect of the rain was less prejudicial when the soil was new to cultivation than it is nowadays. Indeed, in so far as one considers admittedly insignificant effects, the directions of the changes were for the early rains to become less harmful to three-course cotton and more harmful to two-course cotton; for the late rains to become less harmful at the Research Farm and for the middle and previous rains at Taiyiba to become more harmful. For the early rains the apparent contradiction between the direction of this insignificant result of a rigid analysis and the incidental statement quoted by Dr. Balls from the original paper depends partly on the circumstance that the word "correlation" refers only to the closeness with which points fall to a line and tells nothing about the slope of the line or the size of the effects.

CROP RECORDS.

In newly developed areas schemes of management and experimental programmes must be decided from experience over short periods, but erroneous inferences may easily be drawn from memories of

outstanding years and trends or correlations over a few years. Further, unless the early experiments are very happily planned or the outlook unusually conservative, results from a few years may lead to changes in practice which interrupt the continuity. Fortunately, by modern statistical methods, it is possible to assess the significance of relationships derived from comparatively small bodies of homogeneous data, and it is therefore greatly to be hoped that in all new experimental stations or large commercial enterprises suitable precautions will be taken even from the earliest years to provide adequate records both of the weather and of the growth of cotton under as closely standardized conditions as are practicable. Such data may become of the utmost value in determining whether soil fertility or the weather show progressive changes over a few decades. Further, when suitably analysed, they may point to soil or disease factors which might profitably be examined from a new angle, and, if highly successful, they may even lead to methods of crop forecasting. In the present analysis the crop data were restricted to yields, but after some years much more valuable data will be available from the developmental records of the crop observation plots at the Gezira Research Farm and the Record Areas distributed over the commercial land. In Great Britain a somewhat similar beginning has been made in a Crop-Weather Scheme for development data on wheat at ten centres. As the weather varied appreciably from centre to centre it was possible from a preliminary analysis of the first three seasons to establish a number of significant relations between weather and crop growth.

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1. *Proc. Roy. Soc.*, 1935, **118B**, 343-370.
2. *Emp. Cott. Growg. Rev.*, 1935, **12**, 299.

Received February, 1936.

DRAINAGE IN THE SUDAN GEZIRA

THE following letter has been received from Prof. W. Roberts B.C.G.A. (Punjab) Ltd., Khanewal, Punjab, India.—ED.

November 19, 1935.

SIR,

I have followed with very great interest the correspondence regarding above in your January, April, July and October numbers of the *REVIEW*, and would like to express at the outset my appreciation of the high purpose and high ethical level at which the controversy has been conducted. These men, in general, realize at any rate that the problem is far bigger than their own little "egos."

Surely Dr. Balls does not understand field drainage or how drains act. Mr. Barritt remarks that "if it were possible to raise the water table in the Sudan similar to that in Egypt, the drainage of the Gezira soil would then be possible." This is correct, and drains as such could only act now at sixty feet depth or lower! The Gezira is very fortunate in having such a low water table.

The idea behind Dr. Balls's article might be achieved if underground irrigation were tried. For this the pipes would have to be from one and a quarter to two feet deep, and possibly at distances of five or ten feet at most—laterally. If this were tried for some years on, say, a ten-acre field, very valuable results might be indicated. The cost might appear prohibitive, roots might choke the drains, and the swelling of the surrounding clay might put the pipes out of alignment; but this method would open up a bigger or deeper area for cotton roots, and no doubt the mechanical difficulties could be solved in time. Would such a process lead to increased yield? Would it be necessary to give at least one surface irrigation for sowing? These and many other problems would arise, but if the experiment led to distinctly increased yields on the average, then some practical measures might be evolved.

The rigidity of the present system of cultivation on the Gezira, which struck me when I visited it in 1928, would indicate the necessity of exploiting every available idea in the experimental work. With full control of irrigation, the farmer has a powerful weapon with which to make his own "soil climate." The phrase used by the farmer in the Southern States of the U.S.A., regarding "making" bottom, middle or top crop cotton is psychologically the right mental attitude for the Gezira.

Yours faithfully,
W. ROBERTS.

TERMITES AND COTTON GROWING

BY

W. VICTOR HARRIS, M.Sc.,

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TERMITES, or white ants as they are frequently called, are well known as destroyers of timber-work. They are less generally looked on as insects injurious to standing crops, particularly in East Africa, where certain of the more obviously harmful termites, such as the Tea Termite of Ceylon and its allies, are not represented. That termites have another aspect, and can even be regarded as useful insects is less widely appreciated. Let us therefore consider the rôle of the termite in relation to cotton growing, particularly in Tanganyika.

First of all there are the termites which are directly injurious to cotton plants. In Tanganyika I have records of three species which belong to this class—*Hodotermes mossambicus*, Hagen., *Microcerotermes parvus*, Hav., and *Microtermes* sp. The first of these is commonly known as the Marching or Harvesting Termite, from its habit of issuing from small holes in the ground in numbers, getting into regular column-formation and marching off in full daylight to the plant which it proposes to defoliate; much in the manner of the well-known leaf-cutting ant of the West Indies. *Hodotermes* is one of our larger termites, and the single species of the genus occurring in Tanganyika ranges from the Cape to Abyssinia. It is found only in the drier parts of Tanganyika, and only on the fringe of the Lake Province cotton belt (*i.e.*, parts of Shinyanga and Maswa) has it appeared as a cotton pest. The effects produced by this termite in completely defoliating the plant need not be detailed. Fortunately, attacks have been so far of minor importance. Control would be difficult as *Hodotermes* does not build a mound, and the subterranean nests are difficult to locate, while the application of poison baits is not a measure to be recommended in native areas.

The other two species of termite mentioned above have been found tunnelling in the stems of cotton plants—*Microcerotermes* at Morogoro, in the coastal cotton zone, and *Microtermes* at Shinyanga. Both are small, the soldiers being about $\frac{1}{4}$ inch long and the workers about $\frac{1}{8}$ inch. They make subterranean nests, and if required to pass out of the ground for any purpose, they construct earthen tunnels as

shelters. In all cases observed so far injury has occurred to plants growing in red soil deficient in humus, and during the dry season. At Morogoro, *Microcerotermes* was found in the stems of the perennial Moco cotton, but as yet does not appear to have attacked Upland. In Shinyanga, serious damage is done by *Microtermes* to Upland cotton, the insects usually entering the plant in the vicinity of the collar, less commonly via the roots. It has been suggested that high winds cause friction between the collar of the plant and the hard surface of the soil, thus producing an injured area sufficient to permit of the entry of termites. The plants attacked dry out more or less rapidly, or break off at ground-level. The only control measure likely to be effective in the case of these tunnelling termites is to avoid planting cotton on heavily infested land until such times as the soil can be brought into good condition, and the organic matter increased.

Next, there are the termites which are beneficial in that they assist in the rapid destruction of cotton residues, and so help to maintain that "close season" which is such an important feature of cotton pest control in Tanganyika. Concerned here are the large fungus-gardening, usually mound-building species, *Bellicositermes bellicosus*, Smeath., *B. goliath*, Sjost., *B. natalensis*, Hav., *Termes badius*, Hav., etc. They are commonly found covering vegetable debris with their earthen tunnels preparatory to devouring it. The soldiers are large, with reddish-brown rectangular heads and prominent jaws, and make a tapping or rustling noise when alarmed. These termites destroy fallen bolls that might harbour bollworms such as *Platyedra* and *Earias*, and portions of stems and branches liable to contain borers such as the weevil *Apion xanthostylum*. While it must be admitted that these termites deal more efficiently with the residues of grain crops, and that they are much more numerous in the poorer red soils which are not so suited to cotton cultivation, nevertheless their work in this respect cannot be disregarded. A parallel case of the influence of termites on insect pests has been noted in certain areas of the Tanga district, where the absence of the sisal weevil, *Scyphophorus acupunctatus*, is directly correlated with the destruction of old sisal stumps by *Bellicositermes natalensis*.

Finally, there remains the general consideration of termites in relation to soil fertility. Darwin showed the importance of the earthworm in maintaining soil fertility in the temperate and sub-tropical zones, and later Drummond (*Proc. Roy. Soc. Edin.*, xiii. 1896) "brought forward another claimant to the honour of being, along with the earthworm, the leading organic agricultural and

geological agent in nature, the termite." In the tropics, particularly in the low areas where cotton is grown, earthworms are few in number, and their function as stirrers of the soil is taken over by termites. Close examination of the face of any cutting, terrace, or excavation will show what an enormous termite population there is in tropical soils, and the innumerable tunnels, fungus chambers and nests that honeycomb soil and subsoil. Not only is fresh soil brought up from below in the course of these excavations and spread over the surface as food tunnels and mounds, which weather in the tropical rains, but the subterranean excavations provide means for the easy penetration of air and water into the subsoil, and assist the movement of roots. The value of this is particularly noticeable in the red soils of schist origin, which are often free from stones and pack hard without cracks to great depths, rendering penetration difficult. In addition to all this, termites are an important factor in the breaking down of cellulose and lignin, and rendering their component parts once again available as plant food.

It is hoped that this note will serve to indicate to those concerned with the growing of cotton that the study of termites has other aspects than that of their injury to buildings, wooden implements or cotton in storage.

Received December, 1935.

COTTON STATISTICS

BY

JOHN A. TODD, M.A., B.I.

DURING the last two years the outstanding feature of cotton statistics has been the great change, both as regards production and consumption, in the relative figures of American and Outside Growths. In the January issue we pointed out that as the figures then stood the bulk of the expected increase in Outside Growths in 1935-36 was due to the anticipated increase of the Indian crop. That position has since been somewhat altered in two ways: (1) The estimates of many of the other crops have been substantially increased, so that in spite of a further reduction in China our total figure of Outside Growths is now 16,159,000 bales as against the figure we then used of 15,602,000. As the estimate of the American crop was reduced in December to 10,734,000 bales (excluding linters), this means that the total of Outside Growths is once more fully five million bales above the American production. (2) As regards the Indian crop, of which particulars are given in our first table, it is now possible to give more definite figures. The so-called "Final" estimate issued in February (which, however, is subject to revision in the "Supplementary" estimate in April) has now been issued and gives promise of a much more satisfactory yield than we have had in recent years. The acreage increase on last year at the same stage is only about 7 per cent., but even so the area is the largest since 1929, the crop forecast of 5,679,000 bales is the highest since 1925, while the average yield of 91 lb. per acre is the highest since 1927. It should be noted that Ralli Bros.' estimate of this year's crop is still 7,074,000 bales.

It may also be noted that the percentage of long staple cottons ($\frac{3}{8}$ inches and above) in this year's crop promises to be the highest of recent years, if not a new record, practically the whole of the increase in this year's crop being in the long staple districts. Details of this will be given in our July issue when the April figures are available.

Sudan.—The Sudan Government, following their practice of recent years, issued no estimate of the Gezira crop until January; but the figures now available, which are given in our second table,

indicate the prospect of another fairly satisfactory year. With a slight increase of acreage the crop prospect is 646,590 kantars against 657,000 at the same stage last year, though that was ultimately raised to the record figure of 781,555 kantars. Other Sakel areas, however, show very mixed comparisons, the acreage, crop and average yield being all down in Tokar, while in Kassala all three are raised compared with the same date last year, though not with the final results so far as the average yield is concerned. There is also a large increase of the acreage under American cotton, especially in the raingrown districts, but the latest reports from these districts show a reduced yield.

It is satisfactory to note that other Empire crops are also showing very good prospects this season. Uganda, Tanganyika and Nyasaland all look like setting up new records, and the preliminary figures for Nigeria are also well above last year's crop, which was a new record.

Consumption.—On the side of consumption the statistics are now beginning to indicate quite a definite though rather belated swing back from Outside Growths to American. Thus in the United States the consumption of American for the first half of the season totals 2,946,940 bales against 2,622,117 bales for the first half of last season, and it may be noted that Garside's estimate of the World's Consumption of American during the first six months of the season is 6,154,000 bales against his own figures of 5,665,000 last year. His estimate, however, of the World's Consumption of Outside Growths has only risen from 7,249,000 bales to 7,339,000 bales. The following summary shows the progress of the change-over in the figures during the first half of this season:

(000's Omitted.)

	1934-35.			1935-36.		
	<i>American.</i>	<i>Outside Growths.</i>	<i>Total.</i>	<i>American.</i>	<i>Outside Growths.</i>	<i>Total.</i>
August ...	957	1,053	2,010	900	1,129	2,029
September ...	811	1,113	1,924	937	1,226	2,163
October ...	1,042	1,256	2,298	1,070	1,293	2,363
November ...	964	1,292	2,256	1,060	1,241	2,301
December ...	862	1,286	2,148	1,046	1,226	2,272
January ...	1,029	1,249	2,278	1,141	1,224	2,365
1st half season ...	5,665	7,249	12,914	6,154	7,339	13,493
2nd „ „ ...	5,541	6,973	12,514			
Total ...	11,206	14,222	25,428			

The Federation figures of World Consumption for the first half of this season may not be available in time for inclusion in this issue, and when they do appear it is probable that they will be even less complete than they were last season, for it is now doubtful whether the Italian figures will be available.

American Carryover.—The World's Carryover of American cotton is developing very favourably, for in spite of the larger crop the monthly total at the end of January showed a reduction of 967,000 bales from last January. Here again the Federation figures of Mill Stocks outside U.S.A. may not be available before we go to press, but it will be seen that the U.S. Mill Stocks are considerably larger than a year ago.

Prices.—In regard to prices the chief event of the period since our last issue has been the long-awaited decision of the Supreme Court, which found that not only the processing taxes, but the whole system of the Agricultural Adjustment Administration was unconstitutional, on the sweeping ground that the Federal authorities have no power to regulate either agriculture or industry, that being the exclusive province of the various States. The authorities in Washington had all along asserted that, whatever the decision of the Supreme Court, they had alternative legislation ready to meet it; but they have apparently found this much more difficult than they expected, and while a new scheme of area restriction for 1936, based on the Soil Conservation Act of last year, has been prepared and is now before Congress, there is considerable opposition,* and it is very doubtful whether any scheme can be got through in time to effect the desired restriction of acreage for this year. At the same time there has been great uncertainty as to what the Government will do with their huge holdings, which amount to nearly six million bales of cotton from the 1934 crop and previous years. Here again there is considerable difference of opinion as to whether the Government should be compelled by legislation to sell a fixed quantity every week or whether it should be left to their discretion. Meantime these holdings have created a virtual corner in the market, which has enabled the Government, through their holdings of futures in the Pool, to dictate the price of each month as it approaches. It had been hoped that the abolition of the processing taxes would lead to a substantial recovery in sales of cotton goods, and therefore of raw cotton consumption, but owing to uncertainty as to how the benefits of the abolition of the processing tax are to be distributed,

* After many amendments the new Bill passed Congress in the last week of February and was signed by the President on March 2.

and the threat of other taxes to take their place, the markets have not yet shown the expected expansion.

In the case of Egyptian an entirely abnormal position in the Liverpool market developed for a time with regard to the Sakel contract. Certain tenders of Sakel against the Liverpool contract were rejected, which caused something like a corner in near months.

As to spot prices of other varieties, these have on the whole followed the movements of American fairly closely, though with a general tendency to appreciate relatively to American, which, however, has not been maintained. In the case of Sakel the abnormal position of futures above referred to produced, of course, a similar appreciation of spot prices.

For ease of reference we repeat the list of tables given last year, showing the issues in which each will appear:

	<i>January.</i>	<i>April.</i>	<i>July.</i>	<i>October.</i>
World's Crops	×	—	×	—
American crop	×	—	×	×
Indian crop	—	×	—	×
Indian crop by varieties	—	—	×	—
Egyptian crop	×	—	×	—
Egyptian crop by varieties	—	—	—	×
Sudan crop	—	×	—	—
World's consumption (Federation)	×	—	×	—
World's consumption (Garside)	—	×	—	×
U.S. consumption	×	×	×	×
World's Carryover, American	—	×	—	×
World's Carryover, Egyptian	×	—	×	—
Futures prices, American and Egyptian	×	×	×	×
Spot prices, other varieties	×	×	×	×

INDIAN CROP.

(000's Omitted.)

	1930-31.	1931-32.	1932-33.	1933-34.	1934-35	1935-36.*
Area (acres)	23,812	23,722	22,483	24,136	23,830	25,025
Crop (Government estimate)						
400-lb. bales	5,226	4,007	4,656	5,068	4,807	5,679
Average yield per acre (lbs.)	88	68	83	84	81	91
Staple $\frac{3}{4}$ and above (bales)	1,225	1,306	1,347	1,394	1,193	1,939
Per Cent. of Total ...	23.4	32.6	28.9	27.5	24.8	34.1
Staple below $\frac{3}{4}$ (bales)	4,001	2,701	3,309	3,674	3,614	3,740
Per Cent. of Total ...	76.6	67.4	71.1	72.5	75.2	65.9
Commercial Crop :						
Net exports (bales) ...	3,729	1,582	2,868	3,269	—	—
Mill consumption ...	2,271	2,346	2,361	2,336	—	—
Domestic consumption ...	750	750	750	750	—	—
Total	6,750	4,678	5,979	6,355	—	—
Per cent. on Government estimate	+29.2	+16.7	+28.4	+25.4	—	—
Season's average spot price (Liverpool—pence per lb.)	4.02	4.32	4.84	4.52	5.24	—
Per cent. on American ...	70.4	89.6	86.1	75.1	75.6	—

* February estimates.

SUDAN CROP.

	1934-35.				1935-36.*			
	Area: Feddans	Crop: Kantars	Yield per Feddann	400-lb. bales	Area: Feddans	Crop: Kantars	Yield per Feddann	400-lb. bales
Sakel :								
Gezira (Syndicate) ..	156,040	676,290	4.33	200,812	164,178	646,590	3.50	163,264
Gezira (Kassala Cotton Company) ..	19,143	105,265	5.49		20,562			
Tokar ..	31,681	44,964	1.42	10,955	15,200	17,835	1.17	4,414
Kassala (Gash Delta) ..	28,210	69,258	2.45	17,319	38,053	76,000	2.00	18,810
Others ..	6,846	23,842	3.48	8,101	8,070	27,660	3.42	6,846
	241,920	919,619	3.80	237,187	246,063	768,085	3.12	193,334
American :								
Irrigated ..	12,421	34,022	2.74	7,990	11,894	33,633	3.25	8,596
Rain-grown ..	96,916	144,137	1.49	50,954	140,800	126,349	0.89	28,113
Total ..	351,257	1,097,778	3.13	298,131	398,757	933,067	2.34	230,043

Estimates only.

COTTON STATISTICS

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U.S. CONSUMPTION OF COTTON BY VARIETIES.
 (RUNNING BALES 000's: "FOREIGN" IN EQUIVALENT 500-LB. BALES.)

1934-35.	Total.	Daily Rate.	Upland.	American Egyptian.	Egyptian.	Other Foreign.	Linters not Included.
August ...	420.9	18.3	409.4	0.8	7.8	2.9	61.2
September ...	296.0	15.0	289.3	0.3	4.5	1.9	54.7
October ...	520.3	22.9	506.6	0.9	10.4	2.5	57.4
November ...	477.1	22.2	465.1	0.8	8.5	2.7	51.4
December ...	413.5	21.8	403.5	0.8	6.8	2.5	52.1
January ...	546.8	24.0	534.3	0.9	8.7	2.9	61.8
February ...	478.3	24.2	467.1	0.7	7.3	3.1	62.8
March ...	481.1	22.9	469.6	0.8	6.9	3.8	66.8
April ...	462.8	21.3	450.8	1.1	6.8	4.1	70.3
May ...	469.2	20.6	458.8	1.4	5.7	3.4	65.5
June ...	385.9	19.3	376.8	1.3	4.6	3.2	61.9
July ...	391.8	17.8	382.0	1.3	4.7	3.8	62.1
1935-36.							
August ...	408.4	18.6	397.9	2.0	4.7	3.9	57.9
September ...	449.1	21.4	437.6	1.8	5.5	4.2	61.1
October ...	552.2	24.0	538.5	2.0	6.4	5.3	67.1
November ...	507.8	24.8	496.1	1.8	5.2	4.8	59.5
December ...	498.3	26.2	487.3	1.8	5.5	3.7	55.2
January ...	591.3	26.0	578.1	2.2	6.6	4.4	56.0

WORLD'S CARRYOVER OF AMERICAN COTTON.
 (RUNNING BALES 000's, EXCLUDING LINTERS IN U.S.A.)

End of	Stock and Afloat.			U.S.A.		Monthly Totals.	Federation. Other Mill Stocks.	Half-Yearly Totals.	Elsewhere in U.S.A.*
	U.K.	Continent.	Orient.	Mill Stocks.	Public Ware-houses.				
1929, July ...	442	563	—	932	923	2,860	1,197	4,332	275
1930, January ...	618	1,198	448	1,730	5,343	9,337	1,007	10,344	—
July ...	304	544	143	1,048	2,803	4,842	937	6,249	470
1931, January ...	644	1,198	343	1,523	7,895	11,603	907	12,510	—
July ...	436	766	401	922	4,491	7,016	950	8,816	850
1932, January ...	506	938	805	1,583	10,019	13,851	1,193	15,044	—
July ...	415	729	695	1,163	6,657	9,659	1,379	12,798	1,760
1933, January ...	620	1,189	852	1,455	9,982	14,098	1,248	15,346	—
July ...	536	1,058	616	1,298	5,703	9,211	1,259	11,550	1,080
1934, January ...	617	1,367	752	1,557	9,469	13,762	1,320	15,082	—
July ...	405	734	590	1,172	5,526	8,427	1,132	10,509	950
August ...	370	649	545	1,025	5,785	8,374	—	—	—
September ...	340	668	535	1,002	7,575	10,120	—	—	—
October ...	339	696	697	1,088	9,344	12,164	—	—	—
November ...	332	680	713	1,246	9,760	12,731	—	—	—
December ...	345	682	760	1,253	9,605	12,645	—	—	—
1935, January ...	397	640	768	1,148	8,912	11,865	1,060	12,925	—
February ...	363	619	739	1,117	8,338	11,176	—	—	—
March ...	341	567	647	1,074	7,751	10,380	—	—	—
April ...	323	548	595	1,020	7,166	9,654	—	—	—
May ...	276	510	510	938	6,526	8,760	—	—	—
June ...	267	493	445	843	6,045	8,093	—	—	—
July ...	201	395	315	749	5,708	7,368	955	9,003	680
August ...	180	342	238	606	5,865	7,231	—	—	—
September ...	172	373	232	682	7,126	8,585	—	—	—
October ...	324	450	307	1,041	8,463	10,585	—	—	—
November ...	418	658	412	1,314	8,613	11,415	—	—	—
December ...	501	797	499	1,397	8,367	11,561	—	—	—
1936, January ...	493	614	565	1,404	7,822	10,898	—	—	—
February ...	463	637	457	—	—	—	—	—	—

HIGHEST AND LOWEST FUTURES PRICES.

1934-35.	<i>American.</i>				<i>Egyptian (Liverpool).</i>			
	<i>New York.</i>		<i>Liverpool.</i>		<i>Sakel.</i>		<i>Uppers.</i>	
	<i>High.</i>	<i>Low.</i>	<i>High.</i>	<i>Low.</i>	<i>High.</i>	<i>Low.</i>	<i>High.</i>	<i>Low.</i>
August ...	13.84	12.97	7.23	6.77	8.71	8.29	7.54	7.19
September	13.43	12.35	7.00	6.57	8.65	7.87	7.59	7.02
October ...	12.53	11.98	6.70	6.43	8.21	7.65	7.19	6.74
November	12.66	12.02	6.80	6.45	8.85	7.99	7.58	6.97
December	12.72	12.44	6.89	6.64	8.79	8.46	7.64	7.38
January ...	12.75	12.27	6.94	6.75	8.72	8.51	7.75	7.56
February	12.73	12.26	6.88	6.68	8.68	8.36	7.58	7.38
March ...	12.49	10.25	6.97	5.95	8.61	7.69	7.65	6.70
April ...	11.90	10.83	6.54	5.97	8.16	7.86	7.34	6.87
May ...	12.19	10.95	6.56	6.29	8.16	7.86	7.47	7.16
June ...	11.58	10.56	6.17	5.74	7.91	7.62	7.03	6.66
July ...	11.80	11.30	6.28	6.12	7.89	7.67	7.10	6.97
1935-36.								
August ...	11.60	10.31	6.22	5.63	7.86	7.58	7.04	6.42
September	10.81	10.31	5.97	5.52	8.01	7.48	6.82	6.38
October ...	11.27	10.54	6.21	5.77	8.42	7.78	6.87	6.51
November	11.97	10.86	6.54	6.07	9.51	8.44	7.77	6.82
December	11.77	11.01	6.49	6.14	9.20	8.57	7.71	7.28
January ...	11.58	10.90	6.24	5.77	9.22	8.54	7.53	7.03
February	10.99	10.63	5.87	5.66	8.81	8.29	7.14	6.84

Maximum and minimum figures in each season are given in italics.

LIVERPOOL SPOT PRICES OF AMERICAN WITH OTHER VARIETIES
AS PERCENTAGES (LAST FRIDAY OF EACH MONTH).

1934-35.	<i>American (Middling). Pence per Lb.</i>	<i>Indian No. 1 Fine Comra.</i>	<i>West African (Middling).</i>	<i>Brazil Per- nam (Fair).</i>	<i>East African (Good Fair).</i>	<i>Tangais (Good).</i>	<i>Uppers (F.G.F.).</i>	<i>Sakel (F.G.F.).</i>
August ...	7.11	70.5	99.3	98.5	105.6	116.2	105.1	122.9
September	6.91	69.8	99.3	96.4	106.5	116.6	103.9	121.7
October ...	6.92	68.1	98.6	95.7	107.2	114.5	105.2	118.8
November	6.96	70.7	98.1	95.3	106.8	114.7	108.8	129.3
December	7.20	73.8	98.2	95.4	107.9	113.5	109.4	124.2
January ...	7.08	77.5	98.6	95.8	109.9	113.4	112.6	127.1
February	7.10	77.5	99.3	96.5	110.6	113.4	107.3	124.8
March ...	6.36	80.3	99.5	96.4	112.1	114.5	116.8	130.3
April ...	6.78	82.2	99.3	96.3	111.1	113.3	117.1	124.6
May ...	6.92	77.7	97.1	94.9	107.2	109.4	109.8	117.9
June ...	6.85	80.0	98.5	96.4	108.8	109.5	108.2*	117.2
July ...	6.80	81.8	100.0	96.3	106.6	108.8	108.5	118.7
Season's average	6.93	75.6	98.7	95.5	108.4	113.6	109.2	122.9
1935-36.								
August ...	6.21	76.0	100.0	95.2	106.4	108.9	114.2	128.0
September	6.40	78.6	100.0	96.1	105.5	109.4	112.3	133.1
October ...	6.47	84.7	100.8	98.5	109.3	117.0	107.3	140.8
November	6.59	87.3	101.8	99.5	111.7	119.3	120.2	153.9
December	6.41	87.8	101.6	100.0	114.8	119.5	120.1	148.8
January ...	6.14	82.9	101.6	100.0	113.8	121.2	119.1	157.8
February	6.04	82.3	100.8	99.2	111.6	121.5	116.9	149.5

* New Contract.

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

170. REPORT OF THE WORK OF THE INDIAN TRADE COMMISSIONER DURING 1934-35. By Dr. D. B. Meek. Much useful information is given in this report under the following heads: Modern trade tendencies; Agricultural products—food-stuffs, and industrial materials; Indian timbers; Lac and shellac; Indian minerals; Trade publicity; Committees and conferences; Staff and acknowledgments. Various appendices are also included. During the period under review the United Kingdom's imports of both long and short staple Indian cottons increased. The energetic steps taken by the Lancashire Indian Cotton Committee to popularize the use of Indian cottons in Lancashire have resulted in much greater interest being shown in these cottons.

171. LANCASHIRE INDIAN COTTON COMMITTEE. The second annual report of the Lancashire Indian Cotton Committee, issued on January 24, is an admirably printed and well illustrated document. The welcome fact is recorded that the success achieved in 1934 was fully maintained in 1935, the imports of Indian cotton into the United Kingdom in 1935 totalling 394,000 bales, compared with 362,000 bales in the previous year.

Propaganda work, which is the principal function of the Committee, was intensified, and for a second time Indian cottons and goods manufactured from them were exhibited at the British Industries Fair in London, and later in Manchester at the Royal Exchange and at the Shirley Institute. In addition a chart showing the types of Indian cotton regularly available in the United Kingdom, and their characteristics, was distributed free of charge to all spinners in Lancashire, and leaflets and pamphlets stressing the desirability of giving preference to Indian cotton wherever possible were issued from time to time. Tribute is paid to the valuable liaison work of Mr. H. C. Short, the Committee's Commissioner in India, and to the energetic and efficient co-operation of the British Cotton Industry Research Association in carrying out technical investigations and also in making available the services of Mr. S. Taylor to discuss with manufacturers the practical possibilities of an extended use of Indian cottons.

The Committee has always realized that even when the Indian cotton parity is favourable to purchases by Lancashire, many spinners unaccustomed to Indian cotton are reluctant to use it for fear of technical difficulties arising, since the short staple varieties—which alone are available for export in any quantity—require special attention to details in processing. A full examination of the subject has been made by the Shirley Institute, and as a result, those spinners who do not possess the ideal equipment for spinning the short staple Indian cottons have been shown how to adapt their machinery so that it meets all the essential requirements necessary for processing these cottons to the best advantage.

Spinning tests have been carried out on new types of Indian cotton whose cultivation is being extended at the present time, and the results have shown the new Broach strain, B.D. 8, to be very good indeed, clean and of good quality, and suitable for spinning 40's counts from double roving. Experiments on blending various types of Indian cotton and of Indian and American cottons are also in progress, and a good measure of success has been met with.

Many other matters are receiving the attention of the Committee, and it is

beyond question that all that has been done during the past two years has had a very powerful effect in Lancashire. A definite goodwill has been brought about towards Indian matters, and, it is hoped, equally in India towards Lancashire questions. It is no exaggeration to say that this change of atmosphere is an asset of extraordinary importance to both countries. In a mood of mutual confidence and respect, and in a spirit of co-operation, there is almost no problem which the two communities cannot solve together.

The following appendices are included in the report: Statistical Tables and Graphs; Spinners using Indian Cotton, and Yarns produced; Manufacturers using Indian Cotton; List of Piece-goods, etc., made in Lancashire from Indian Cotton; Suppliers of Indian Raw Cotton, (a) in India, (b) in the United Kingdom.

The report is a valuable and interesting document. Copies will be supplied free on request to the Secretary of the Committee, 333-350 Royal Exchange, Manchester 2.

172. INDIAN COTTON: REVIEW OF THE 1934-35 SEASON. We have received from Messrs. Chunilal, Mehta and Co., Bombay, a copy of the *Indian Cotton Review for the 1934-35 Season*. The consumption of Indian cotton by the mills in India constituted a record of 2,611,000 bales, compared with 2,336,000 bales in the previous season. Several mills worked double shifts. The absence of any serious labour trouble also contributed towards the increased consumption of raw cotton in India. The consumption of Indian cotton abroad amounted to 3,040,000 bales, compared with 2,535,000 bales in 1933-34. The present world consumption averages 500,000 bales a month.

Prospects for the 1935-36 Season.—The year's monsoon has been highly satisfactory, and no serious damage to the crop has been reported from anywhere. An 8 per cent. increase in the cotton acreage is estimated, and given normal weather conditions during the next few months, a crop of about 6,200,000 bales can be anticipated in India.

The report contains several tables of statistics dealing with the world supply, distribution and stocks of Indian cotton, Bombay cotton prices, Bombay weekly cotton movements and stocks, Indian cotton acreage and crop, consumption of Indian cotton in India, exports, etc.

173. INDIAN CENTRAL COTTON COMMITTEE. We have received a useful and well illustrated pamphlet giving a brief account of the objects for which the Committee was formed, and what has been accomplished in the fourteen years of its existence. Much valuable work has been done to encourage the growth of improved varieties, to extend the area of cultivation, and to stimulate and assist in every possible way the production, marketing, and manufacture of Indian cotton. An account is also included of the work of the Technological Laboratory, Bombay, the Institute of Plant Industry, Indore, and of the research work on cotton in Madras, Bombay, Central Provinces, United Provinces, Punjab, etc. [Cf. Abstr. 325, Vol. XI. of this Review.]

174. INDIAN CENTRAL COTTON COMMITTEE. We have received from the Publicity Officer the following notices:

Amalner Cotton Market.—The first report, issued in 1934-35, deals with the activities of the market which was established at Amalner in the Bombay Presidency in November, 1934.

Development of Cotton Cultivation in Sind.—The report of the Dept. of Agriculture, Sind, for 1933-34 discusses *inter alia* the botanical work, physiological investigations, and the Sind Cotton Extension Scheme.

175. SPINNING TEST REPORTS ON INDIAN COTTONS. By N. Ahmad. (*Ind. Cent. Cott. Comm. Tech. Circs.*, Nos. 198-207, 1934-35.) The circulars contain

the report of the Standards Committee and spinning test results for Surat, Tinnevely, Cambodia, Karunganni, Bijapur, Bagalkhote, and Kumpta cottons, and the report of the Special Appeal Committee on African Cottons and spinning test results for Jinja, Busoga, and Kampala cottons for the 1934-35 season.

176. REMARKS ON PRIMARY CULTIVATION UNDER INDIAN CONDITIONS WITH SPECIAL REFERENCE TO SOIL INVERSION. By R. G. Allan. (*Agr. and Livestock in India*, v., 4, 1935, p. 351.) An interesting account of the methods of ploughing, the types of ploughs found most suitable, and of other primary operations in the cultivation of land under conditions that prevail in India.

The author not only brings together and attempts an interpretation of the results of a number of scattered experiments—very few of which were laid out on modern lines—but also gives the results of many years' personal experience in cultivation experiments under Indian conditions. Whilst a certain number of definite conclusions have emerged from the examination of existing data, the need for modern field experiments on this important subject is made abundantly clear.

177. COTTON IMPROVEMENT WORK IN HYDERABAD STATE. By K. Sawhney. (*Proc. Ass. Econ. Biol.*, Coimbatore (1934), 1935: ii., p. 41. From *Pl. Bre. Absts.*, vi., 2, 1936, p. 110.) Though a highly valued variety on account of its spinning properties, *Hyderabad gaorani* has three great drawbacks, low yield, high proportion of seed to lint, and bolls which do not open fully. As a result, short staple varieties have tended to replace it, and breeding work has been undertaken to re-establish the *Gaorani* variety.

About six superior strains from this cotton are now under test. Other methods employed were the introduction of varieties from other parts of India—which did not meet with much success—and selection among the progeny of a cross between *Gossypium neglectum* var. *rosea* and Bani 306. From the cross a type with the plant habit and ginning outturn of *roseum*, but with a staple length of nearly one inch, has been produced. Work is also in progress on American varieties.

178. MADRAS: COTTON CULTIVATION, 1934-35. (*Rpt. of Operns. of Dpt. of Agr. Madras*, 1934-35.) The three years' trial of the new Cambodia strains Nos. 920, 1267 and 1742 showed the superiority of the last two over Co. 2, and they will be multiplied up for distribution. At Guntur Station the new strain No. 12 gave a 45 per cent. increase over the control. At Nandyal the strain H-1 from Hagari yielded well. At Koilpatti it was found that Karunganni was superior to Uppam. No. 2622, an early maturing strain which was considered equal to C. 7 at the research station, and superior in two out of three district trials, is being multiplied up for distribution.

179. DETERIORATION IN THE QUALITY OF CAMBODIA COTTON. By V. R. Ayyar. (*Madras Agr. J.*, 23, 1935, p. 321. From *Pl. Bre. Absts.*, vi., 2, 1936, p. 113.) Among the factors that contribute to deterioration in the quality of a strain of cotton are mentioned hybridization with inferior varieties, and the play of natural selection on factors which may have been left impure when the strain was selected, and which have a modifying effect on the economic characters. Neither of these is considered to have occurred in this case, nor does the author consider that Cambodia cotton has in actual fact deteriorated.

180. THE INFLUENCE OF METHOD OF PICKING ON THE QUALITY OF CAMBODIA COTTON. By N. Ahmad. (*Tech. Leaf.* 5, Ind. Cent. Cott. Comm., 1935.) In view of complaints received regarding the amount of trash present in Indian cottons due to careless and faulty picking, experiments were carried out whereby the kapas was picked only from fully opened and mature bolls, leaving the locules

in the plant itself. The results showed a higher percentage of mature fibres, gave 3 per cent. less total loss in the opening and cleaning processes, registered fewer breakages in the ring frame, and the yarns were definitely stronger and less neppy than from cotton picked according to the cultivators' usual method.

181. CAUSES OF FLUCTUATION OF AREA UNDER COTTON IN THE CANAL COLONIES OF THE PUNJAB. By S. S. Jaggi. (*Agr. and Livestock in India*, v., 6, 1935, p. 712.) The factors that may be operative are: the market price of cotton during the previous year; the yield per acre in the previous year; area under competing crops such as sugar-cane and maize; possible scarcity of canal water at sowing time.

182. STUDY OF AGRICULTURAL CONDITIONS UNDER WHICH DESI AND AMERICAN COTTONS ARE GROWN IN THE LYALLPUR DISTRICT. By S. S. Jaggi. (*Agr. and Livestock in India*, v., 6, 1935, p. 703.) *Summary*: In all 64 villages and 953 cultivators were visited for the purposes of this enquiry. 2,555 acres of Desi cotton and 2,192 acres of American cotton were dealt with. The average yield per acre was 4.48 mds. for Desi cotton and 5.35 mds. for American cotton. On the whole, American cotton was grown under more favourable conditions with regard to soil, irrigation, manure, etc. The number of irrigations given to Desi and American cottons varied from three to five and four to six respectively. 65 per cent. of the area under Desi cotton was sown after wheat, 18 per cent. after *toria*, and 17 per cent. after cultivated fallow, sugar-cane, maize, *senji*, and vegetables. In the case of American cotton 36.5 per cent. was sown after wheat, 20.5 per cent. after *toria*, and 43 per cent. after cultivated fallow, sugar-cane, maize, *senji*, and vegetables.

183. SOME ASPECTS OF MARKETING AND COST OF TRANSPORTATION OF COTTON. By A. Singh and P. S. Bhullar. (*Agr. and Livestock in India*, v., 6, 1935, p. 692.) Gives the results of an enquiry conducted to ascertain the conditions under which seed cotton is transported from villages to the Lyallpur market for sale.

184. SIND: COTTON CULTIVATION, 1933-34. (*Ann. Rpt. of Dpt. of Agr. Sind, 1933-34.*) This report, which has recently been received, states that the season generally was favourable to cotton, and the yield was approximately 250,000 bales of 400 lb. compared with an average yield for the preceding ten years of 100,870 bales. The chief pests encountered were bollworm, jassid, and lucerne caterpillar. At the Sakrand and Mirpurkhas stations research work was continued on the further improvement of staple varieties—i.e., Sind-American and Egyptian, suitable for the Barrage areas. A strain of Punjab-American cotton, 289F-20, showed great promise, and was under multiplication at Mirpurkhas. Physiological research was also continued, especially in regard to the economics and technique of the application of irrigation water to cotton. At the Chemical Section at Sakrand experimental work was in progress to devise modifications of the Indore system of compost manufacture in order to adapt it to Sind conditions.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

185. The following reports have recently been received:

DEPT. OF SCIENTIFIC AND INDUSTRIAL RESEARCH: Rpt. for 1934-35.

SOUTH-EASTERN AGRICULTURAL COLLEGE, WYE: *The Journal*, January, 1936.

CEYLON: Admin. Rpt. of Dir. of Agr. for 1934.

GOLD COAST: Rpt. of Dpt. of Agr., 1934-35.

NIGERIA: Rpt. of Agr. Dpt., 1934.

SOUTH AFRICA: Ann. Rpt., 1935 (*Farming in S. Afr.*).

„ Official Year Book, 1933-34.

„ South and East African Year Book and Guide for 1936.

SUDAN: Ann. Rpt. on Admin., Finan. and Condition of Sudan in 1934.

FJI: Ann. Bull. of Div. Rpts., 1934.

QUEENSLAND: Ann. Rpt. of Dpt. of Agr. and Stock, 1934-35.

WEST INDIES: *Trinidad and Tobago*, Admin. Rpt. of Dpt. of Agr., 1934.

186. REPORTS FROM EXPERIMENT STATIONS, 1934-35. (Pubd. by the Empire Cotton Growing Corporation, 1936. Price 2s. 6d. post free.) In accordance with the scheme inaugurated last year progress reports are included summarizing the work carried out during the 1934-35 season at the Cotton Experiment Stations in Queensland, South Africa, Swaziland, Rhodesia, Sudan, Uganda, Tanganyika, Nyasaland, St. Vincent, Fiji, and the Seed Farm in Nigeria. A valuable addition to the volume is the reports from the stations in Northern and Southern Nigeria, respectively, which have been included by courtesy of the Government of Nigeria.

Good progress was made with the important breeding work carried out at the various stations. U.4 and its derivatives continued to meet with much success in South Africa and the colonies to the north of it, and other promising strains were also evolved. A great deal of useful work was carried out in connection with rotation of crops, time of planting, spacing, and manuring experiments, and in the control of pests and diseases.

The reports should prove of interest and use to those concerned with the breeding and cultivation of cotton and similar crops.

187. A REVIEW OF THE WORK OF THE EXPERIMENT STATIONS, SEASON 1934-35. By J. C. Willis, F.R.S. (Pubd. by the Empire Cotton Growing Corporation, 1936. Price 1s. 6d. post free.) A general review, written in non-technical language, of the work carried out at the Experiment Stations during the 1934-35 season, and of the progress made. Section I. is concerned with Plant Breeding; Section II. with the improvement of Agricultural Practices; Section III. with Pests and Diseases.

188. REPORT OF THE DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, 1934-35. (Cmd. 5013. Pubd. H.M. Stat. Off., 1935. Price 3s. net.) The twentieth report contains the report of the Advisory Council, and a general review of the work carried out under the supervision of the Boards and Committees of the Department, together with a section describing the work of Research Associations.

189. LIST OF AGRICULTURAL RESEARCH WORKERS IN THE BRITISH EMPIRE, 1935. (H.M. Stat. Off., 1935. Price 2s. 6d. net.) The list gives the names and addresses of agricultural research workers as on June 30, 1935, with the branch of science in which each is specially interested. It is divided into four parts: Part A gives details of the Bureaux organizations formed for the distribution of scientific information among research workers; Part B gives the names and addresses of research workers arranged under countries; Part C classifies them according to the subjects in which they are interested; Part D is an index.

190. ASIA. CEYLON: *Cotton Cultivation, 1933-34.* (Ann. Rpt. Dpt. of Agr., 1934, recently received.) Owing to the encouragement given by the slightly higher rate offered for seed cotton by the Wellawatte Spinning and Weaving Mills for the 1932 crop, there was an increased acreage under cotton during the 1933-34 season. The Government purchase during 1934 amounted to 956 cwt. of seed cotton, as against 126 cwt. in 1933, and as before was sold to the local spinning and weaving mills for Rs. 12 per cwt. of first grade seed cotton. In the Hambantota, Dambulla, and Middeniya districts cotton would be a popular crop if growers

could be assured of more remunerative prices. At Dambulla some injury to the crop was caused by the leaf-eating caterpillar, *Sylepta derogata*.

191. COTTON CULTIVATION IN THE CENTRAL DIVISION. By H. A. Peiris. (*Trop. Agriculturist*, lxxxv., 5, 1935, p. 325.) Notwithstanding the factors that militate against cotton cultivation in the Dambulla district, which include lack of suitable peasant proprietary schemes, transport difficulties, malaria, damage by wild animals, and general poverty of cultivators, the author states that cotton cultivation has made good progress during the past three years. In 1934-35 some 38,826 lb. of seed cotton were purchased, compared with 2,756 lb. in 1930-31. A cotton production campaign has been organized with a view to bringing a larger area under cultivation.

192. CYPRUS: Cotton Cultivation. (*Bull. of Imp. Inst.*, xxxiii., 3, 1935, p. 335.) Cotton is grown in the plains during the summer months, but the area planted during recent years has been reduced owing to scarcity of water for irrigation. The improvement of cotton prices during 1934 resulted in a greater local interest being taken in cotton production. The Agricultural Department has produced a promising selection from a Cyprus variety of cotton, and its cultivation is being gradually extended. Variety trials are also being carried out with a view to evolving high-yielding types suitable for the general conditions prevailing in the island. The principal market for the crop is Greece.

193. AFRICA. GOLD COAST: Cotton Cultivation, 1934-35. (*Rpt. of Dpt. of Agr.*, 1934-35.) A more favourable season was experienced for cotton growing in Togoland. A total of just over 81 tons of seed cotton was exported over the frontier as against 30 tons in the previous year. Some of the Cotton Growers' Co-operative Societies were disheartened by the experience of last year and closed down, but eighteen persisted and finally dealt with some 12 tons of seed cotton, for which they received prices ranging from £11 to £12 10s. per ton. A quantity of seed of the latest improved Nigerian strain of Ishan cotton has been ordered and will be grown for issue in the district in due course. The policy in the Northern Territories remains unchanged, and an improved strain of Allen cotton (D. 28) is merely maintained on a small scale for future contingencies. The price which could be offered in this area, so remote from rail transport, is still too low to attract growers. At Tamale two rotations which have been in operation for six years have shown that fertility can be well maintained by the growth and turning-in of a crop of Bengal beans during the rotation. The first is a five-year rotation embracing yams, cotton, guinea-corn, maize and groundnuts mixed, and Bengal beans. The second is a shorter three-year rotation dealing only with yams, maize and groundnuts, and Bengal beans.

194. NIGERIA: Cotton Cultivation, 1934-35. (*Half-Yearly Rpt. of Dpt. of Agr. to September 30, 1935.*) *Northern Provinces.*—The purchases of American cotton for export amounted to 50,022 bales, and thus the 50,000 bales "milestone" so long looked forward to has been reached at last. The price paid (in pence per lb. of seed cotton) was 1-1d. rising to 1-2d., as compared with 9d. rising to 1-2d. in 1933-34. The new marketing regulations mentioned in the previous report have been passed, and steps are being taken to bring the new system into force in the coming season.

The total quantity of American cotton seed distributed for planting in 1935 was 5,170 tons, as compared with 3,807 tons in the previous year. The yield is expected to reach 70,000/75,000 bales.

Southern Provinces.—The purchases of Improved Ishan cotton for export amounted to 5,208 bales. Practically the whole of the crop was again third

grade. 185 tons of Ishan seed were issued for planting in 1935, and a yield of some 12,000 bales is anticipated.

195. *Cotton Investigations.* (*Bull. Imp. Inst.*, xxxiii., 3, 1935, p. 372.) From the report of the Botanical Section, Southern Provinces, covering the period January-June, 1935, we learn that Ishan A is still the most satisfactory cotton, its principal defect being the roughness of the lint. Attempts are being made to graft the smooth lint character of Sea Island on to Ishan A. The cottons have been crossed and the F_1 has been backcrossed on to Ishan A for two generations. During the 1934-35 season both first and second generation backcrosses were under trial at Moor Plantation, but the abnormal rainfall experienced resulted in heavy loss of crop, and handicapped the selection work. Selection was largely based on vegetative and lint characters. Towards the end of the growing season a rigorous field selection on the vegetative character was made, particular attention being paid to hairiness. As bolls opened, plants passing this test were further selected for smoothness of lint. A final selection followed in the laboratory, when halo lengths and ginning percentages were determined, and twenty-six selections were made for next season. The trials were not successful in eliminating the rough lint character of Ishan A.

196. AGRICULTURE IN NIGERIA. By O. T. Faulkner. (*W. Afr. Rev.*, vi., 93, 1935.) During the last twenty-five years the agricultural exports of Nigeria have increased roughly as follows: Cocoa, twentyfold; cotton, tenfold; groundnuts, two hundredfold; benniseed, fortyfold; palm kernels, 50 per cent.; and palm oil, 50 per cent. The expansion that has occurred in cotton growing is due almost entirely to the introduction of American cotton into the Northern Provinces, and to the supervision by the Agricultural Department of seed distribution, grading, and marketing. The commercial export of American cotton produced by native farmers in the Northern Provinces began in 1915-16 with 121 bales; in 1934-35 the export was over 49,000 bales, and in 1935-36, with good weather conditions, a further increase is expected. The native cotton in Oyo and Abeokuta has been replaced by Improved Ishan, a cotton of superior quality bred locally by the plant breeders of the Department. Unfortunately, this cotton was introduced just previous to the depression, and in consequence did not make much headway, only 860 bales being exported in 1932-33. Although the 1934-35 crop of Improved Ishan cotton is not expected to exceed 4,500/5,000 bales, steady progress is, however, now being made. The ordinary indigenous cottons of Nigeria are of inferior quality, and are only exportable in periods of exceptionally high prices. The work of the Agricultural Department in introducing better varieties of cotton will, it is anticipated, result in a total export of nearly 60,000 bales in 1934-35.

197. SOUTH AFRICA: *Cotton Cultivation* 1934-35. (*Farmg. in S. Afr.*, x., 117, 1935, p. 511.) Encouraged by the quality of the crop of the previous season and the prices obtained, a bigger acreage was put under cotton in several areas during the past planting season. Setbacks were, however, experienced during the growing season, hailstorms causing damage in Weenen and the Eastern Transvaal, and aphid infestation also affecting the yield in certain areas. Nevertheless the cotton grower experienced a better season than for a considerable time past. There was no difficulty in disposing of the crop, competition amongst buyers being quite keen and the prices realized very satisfactory. It is a cause of great satisfaction that the official cotton graders commented very favourably on the quality of the crop.

In connection with the anti-soil erosion schemes commenced in 1933, the vast machinery required to put the schemes into practice, both in respect of administration and field work, has been more or less completed, and the work is making headway in a most satisfactory manner.

198. THE SOUTH AND EAST AFRICAN YEAR BOOK AND GUIDE FOR 1936. (Edited for the Union Castle Mail Steamship Co., Ltd., by A. Samler Brown and G. Gordon Brown.) The mere fact that this is the 42nd edition is sufficient to show that this work must have "something in it," and one has only to turn over the pages to see that it would not be easy to find something of immediate practical value that is not in it. Much useful information is given about the voyage out to South Africa, hotel tariffs, cost of living, customs, scenery, native races and languages, education, etc. An interesting account follows of the history of South Africa from the time of the early discoveries of the Portuguese down to a very recent date. Climate and topography are equally well treated, and the matter of the great amount of sunshine in the country is emphasized. Public health, geology, and openings for immigrants are also discussed. The individual States are then described in detail, and this is followed by articles dealing with labour, native policy, acquisition of land, irrigation, farming, mining, etc. The remainder of the part devoted to South Africa is occupied by descriptions of thirty-six different routes of travel. The second half of the book deals in a similar way with East Africa. Finally, a series of excellent maps is included which adds very greatly to the value of the whole. No one with interests in South or East Africa can afford to be without this book.

199. SUDAN: *Types of Agriculture in the Northern Sudan.* By F. E. Kenchington. (*Trop. Agriculture*, xii., 9, 1935, p. 235.) A very readable and informative account of the agriculture of this hot and dry country. A great part of the paper is taken up with an account of the different systems of irrigation practised, including the native "shadoof" and "sakia" systems which have been in operation for centuries. A list is given of the various crops cultivated.

200. SUDAN PLANTATIONS SYNDICATE: *Cotton Cultivation, 1933-34.* (*Rpt. on Admin. Finan. and Condn. of the Sudan in 1934*, recently received.) The average yield per foddan over the total area planted of 155,902 feddans was 2.31 kantars. Phenomenally late and heavy rains caused the rapid spread of blackarm, and the yield was further reduced by leaf curl and bollworm.

Prospects for 1934-35 are above average and a good crop is anticipated. The season started badly with extensive early rains and a consequent heavy growth of weeds, but a break in the weather enabled the land to be cleaned and the new crop sown. Blackarm appeared early, but did little damage. The financial position of some of the tenants, especially in the northern area, has improved. The demand for tenancies exceeds the supply, and people living outside the scheme clamour for their land to be included in the rented area.

201. UGANDA: *Cotton Prospects, 1935-36.* The latest report from the Department of Agriculture states that the dry period of mid-December has been followed by a rainfall above normal, and heavy rains have been experienced up to date in many areas. In most parts of the Eastern and Northern Provinces these late rains were too late to effect any improvement in the yield, and have adversely affected the grade. In areas west of the Nile the late rains have been beneficial to the late sowings, and crop prospects have, if anything, improved. It is considered that, given dry weather conditions from now onwards, production should reach 305,000 bales.

202. *Cotton Prospects.* (*Crown Colonist*, January, 1936, p. 41.) With a continuance of normal weather, prospects for the cotton crop are very bright. Experts are already forecasting 300,000 bales; this would mean £1,000,000 more in circulation than last year. The crop is looking exceptionally healthy and strong throughout the country, with little or no pests or disease. The bazaars are

coming to life, trade has begun, and substantial orders have been placed with wholesalers.

203. Cotton Experiments. (*Bull. Imp. Inst.*, xxxiii., 3, 1935, p. 374.) The half-yearly report on investigations carried out at Serere Plantation for the period January-June, 1935, contains a summary by the Assistant Botanist of the results of the main experiments, including a miniature variety trial; sowing date and spacing trial with S.G. 29; combined variety, dusting, and sowing date trial; manurial experiment; and rotation experiment. The outstanding results are: the obvious preference of the strain S.P. 48 for late planting and its considerable increase in yield over S.G. 29; the increase of yield of successive generations of the strains S.P. 1, S.P. 20, S.P. 21, and S.P. 48, all of which are U. 4-4-2 derivatives; the failure of dusts to alter general yield except during June, despite the significant reduction of blackarm infection.

204. UGANDA. By H. B. Thomas and R. Scott. (Oxford Univ. Press: Humphrey Milford, London, 1935. Price 15s.) It is stated that the last official handbook on Uganda was published in 1920, and since then the enormous advances made in every way in the country have shown the necessity for more up-to-date information. The present work has been compiled by two members of the Uganda Protectorate Civil Service by authority of the Uganda Government; it is not, however, an official publication although compiled from official records. The introduction is written by Sir Bernard H. Bourdillon and a foreword is contributed by Lord Lugard, both of whom have extensive knowledge of Uganda affairs, the latter in the early years and the former more recently.

The work commences with a brief historical survey of Uganda from its earliest known history to the present day, followed by chapters dealing with natural features, climate, and geology. The constitution and machinery of government are then discussed in detail in a chapter which should prove invaluable to those interested in Africa who are as yet unacquainted with the machinery of government in our Colonies and Protectorates there. Chapters follow dealing with the native peoples of Uganda, land and land tenure particularly in relation to native affairs, native agriculture and food supply, the supremely important cotton industry, the extension of economic agriculture, forests, botany, zoology, minerals and mining, roads, railways, air transport, finance, taxation, justice, native life, public health, education, Christian missions and native religious organizations, trade and commerce. The armed forces are also reviewed from their early beginnings to the present stages of development. The information contained in all these chapters serves to give some idea of the great advances that have been made in Uganda, the difficulties that have been overcome, and the enormous amount of work that still remains to be done.

Finally, the visitor to Uganda is catered for, and much useful information is given regarding game and hunting, licenses, sports clubs, places of interest and beauty in the country.

The book is furnished with a good index, and seventeen appendices and eight maps are also included. The authors are to be complimented on giving in so full yet concise a manner information on every aspect of interest in the Protectorate.

205. AUSTRALASIA. QUEENSLAND: Cotton Cultivation, 1934-35. (*Ann. Rpt. of Dpt. of Agr. and Stock, 1934-35*, received 1936.) Weather conditions were favourable up to mid-January, but thereafter extreme dryness prevailed until the end of June, and the hopes of a record crop were not realized. Growers maintained a satisfactory standard of cultivation, and this undoubtedly had an effect on the final yield. Rotation studies carried out at the Cotton Research

Station, Callide, indicated that increased yields resulted in dry seasons when cotton succeeded Sudan grass, saccaline, maize, panicum, and similar fodder crops. The greatest success, however, was obtained when cotton followed two years of Rhodes grass.

Cotton pests, with the exception of corn earworm, caused little injury during the season, and apart from angular leafspot there were no serious cotton diseases.

The expansion of the Australian market for cotton yarns as a result of tariff adjustments to meet the needs of the industry, was one of the outstanding experiences of the year. The payment of bounty on lint, instead of seed cotton as formerly, was also a favourable factor in the year's development of the industry.

The average prices paid to growers showed an improvement on those of the past two seasons.

206. Cotton Cultivation, 1934-35. (*Queensland Agr. J.*, xlv., 4, October, 1935, p. 512.) The total cotton production amounted to 14,505 bales of 500 lb. This was appreciably less than was expected at mid-season, but was considered satisfactory in view of the exceptionally dry conditions experienced from January to the end of the season.

Prospects for the 1935-36 Season.—At the time of writing prospects were promising in all districts except the South Burnett and the Southern district, where further rain was badly needed. Sufficient seed to plant at least 50,000 acres had been purchased.

207. Cotton Varieties. (*Int. Cott. Bull.*, xiv., 52, 1935, p. 21.) The varieties that are most successful in Queensland are: Lone Star, a big boll type grown in the Central Burnett district, the lint of which is much sought after by Australian spinners; Durango, a long-stapled cotton which has been acclimatized for over twelve years; Miller Mebane, Indio Acala, Cliett, Starvale, and Boykin.

208. Cotton Planting. By R. W. Peters. (*Queensland Agr. J.*, xlv., 4, 1935, p. 436.) Information is given in connection with the time and methods of planting, planting equipment, depth of sowing, advantages of delinted seed, rate of planting, spacing and direction of rows.

209. Cultivation of Cotton. By R. W. Peters. (*Queensland Agr. J.*, xlv., 5, 1935, p. 582.) Instructions are given to the beginner on the preparation of the seed bed, cultivation, cultivator equipment, etc.

210. FIJI: Cotton Cultivation, 1933-34. (*Ann. Bull. of Div. Rpts., Fiji*, 1934, recently received.) Seed cotton deliveries at Sigatoka and Lautoka of both Sea Island and Fiji backcross types were exceedingly clean, and practically no low grade cotton was received. The Sea Island lint was free of immature and dead hairs, the staple was regular, fairly strong and free of stain; Fiji No. 172 lint was of good strength and colour and free of trash, but the staple was somewhat irregular. Some difficulty was experienced in getting labour at economic prices at the gineries, and in addition the gas plant and engine at Sigatoka gave considerable trouble. The area cropped was 128 acres, worked by 98 cultivators, who produced 49,711 lb. of seed cotton, giving 3,924 lb. of Sea Island lint and 11,840 lb. of lint of Fiji No. 172. The future of cotton in Fiji is problematical, since it has to compete with sugar-cane, from which better returns are received. For the 1934-35 season an effort was made to increase the acreage planted to 700 acres, but as a result of the very prolonged drought only 220 acres were planted.

211. WEST INDIES. SEA ISLAND COTTON ASSOCIATION. (*West Ind. Comm. Circ.*, li., 974, 1936, p. 54.) The third annual general meeting of the West Indian Sea Island Cotton Association was held in January in St. Vincent. In his

speech the president, Mr. G. A. Jones, spoke of the marked improvement which had taken place in the Sea Island cotton market since the formation of the Association. He also noted as of importance the appointment of the Advisory Committee in England; the interest taken in the sale of Sea Island cotton goods in this country by Mr. Austin Reed; the inspection by the then Secretary of State for the Colonies, Sir Philip Cunliffe Lister (now Lord Swinton), of an exhibition of such goods in London; and the radio "talks" on this subject by Sir Algernon Aspinall.

212. ANTIGUA: *Cotton Cultivation*, 1935-36. (*Trop. Agriculture*, xiii, 1, 1936, p. 10.) The cotton crop of 1935 met with a ready sale. The acreage for 1936 has been extended to 600 acres. There are considerable areas in the island well suited to cotton, which should become a major crop especially for the peasant class. By arrangement with the Agricultural Department of Montserrat pedigree seed is imported each year and is bulked up under the supervision of the Antigua Department of Agriculture.

213. MONTSERRAT: *Cotton Cultivation*, 1935. (*Trop. Agriculture*, xiii., 1, 1936, p. 10.) The crop has been a record one, and over 900,000 lb. of clean lint have been produced. Keen competition prevailed in the island for the seed cotton and lint and good prices were paid. Most of the cotton was sold before it was exported, and it is evident that even larger quantities could have been disposed of. Late planted cotton suffered severely from the ravages of pink bollworm.

214. ST. KITTS-NEVIS: *Cotton Cultivation*, 1934-36. (*Trop. Agriculture*, xiii., 1, 1936, p. 9.) The Sea Island cotton crop in St. Kitts during 1935 was small in area, but satisfactory yields were obtained. During the last two years two types of cotton have been grown on the island, the tendency at present being to extend the Montserrat type, which is rather shorter and less fine than the local strain. Both types this year have sold readily, but there was an inclination on the part of buyers to cut down the premium which the St. Kitts strain usually commands. It is anticipated that a larger area will be planted during 1936 if this is recommended by the West Indian Sea Island Cotton Association, of which body the St. Kitts planters are keen supporters. In Nevis the late arrival of the rains enabled some 2,000 acres to be planted in Sea Island cotton for the 1935-36 crop. The cotton crop of 1934-35 has been disposed of at a figure that will enable the Government-owned ginnery to pay a price of 7.7 cents per lb. for seed cotton.

COTTON IN EGYPT.

215. EGYPTIAN COTTON: INFLUENCE OF VARIETY, SPACING, MANURING AND WATER SUPPLY ON YIELD. By F. Crowther and A. Mahmoud. (*Roy. Agr. Soc. Egypt. Tech. Bull.*, No. 22, 1935. From *J. Text. Inst.*, xxvi., 12, 1935, A609.) The interrelation of variety, spacing, nitrogen manuring and water supply was investigated, with reference to cotton yield, in two large-scale field experiments in Egypt in 1934. The different varieties showed marked variation in their response to nitrogen applications. In one experiment an average response in yield of 3 per cent. resulted from a single nitrogen application, and in the other experiment a response of 19 per cent., but there was no response to a double nitrogen application owing to its being too late to be utilized by the bolls of the final crop. In both experiments the medium spacings gave the highest yields, the optimum showing little variation with variety, manuring or watering. Increasing the amount of water given at each irrigation had in general no significant effect on yield.

216. THE GRADING OF EGYPTIAN COTTON. (*Int. Cott. Bull.*, xiv., 53, 1935, p. 54.) The Egyptian Ministry of Finance has approved the extension of the grade range of all cottons tenderable through contracts at periodically fixed differences to include FGF/Good. This applies to the Sakel and Ashmouni contract alike, and takes effect as from May 1936 delivery in the former, and as from April delivery in the latter. Another modification of existing regulations establishes that, as from April 1936 delivery, Zagora will no longer be tenderable on the same basis as Ashmouni, but will be susceptible to a penalty or a bonus, as the case may be, determined by its market price-parity with Ashmouni (the basic variety) at the period of delivery.

217. STAPLE CHARACTERS OF EGYPTIAN VARIETIES. By C. H. Brown. (*Int. Cott. Bull.*, xiv., 52, 1935, p. 54.) Staple length measurements of the following varieties are given in the hope that the figures may be of use to spinners of Egyptian cotton: Ashmouni, Fouadi, Sakel, Maarad, Sakha 4, and Giza 3, 7, 12, 26. The spinning value of all these strains (except Ashmouni and Fouadi), and their market price, are discussed.

COTTON IN THE UNITED STATES.

218. AMERICAN COTTON CROP, 1934-35. By H. Plauche. (*Cotton*, M/c, 41, No. 1985, 1935, p. 11.) Statistics, taken from the *U.S. Dept. of Agriculture Annual Review*, are given for production, price, internal mill consumption, exports, etc., for American raw cotton, in particular reference to the 1934-35 crop. The unsatisfactory conditions prevailing in the industry are attributed in great measure to the Government's price-controlling policy.

219. NEW FOUR-YEAR COTTON ADJUSTMENT PROGRAMME. (*Int. Cott. Bull.*, xiv., 54, 1936, p. 166.) It was announced recently that a new four-year cotton adjustment programme, which would be offered to cotton producers to replace the contract expiring at the end of the 1935 season, had been approved by the Secretary of Agriculture. The contract covers the calendar years 1936-39 inclusive. A total base acreage of 44,600,000 acres has been adopted, and will be allocated among the various cotton-producing states upon a basis corresponding to the base acreage in 1935 in each state. Allocation to counties will be made from the state's quota, but 10 per cent. will be held for apportionment by the State Cotton Board to be used in adjusting the acreage for counties and individual producers. The minimum adjustment required for 1936 will be a reduction of 30 per cent. below the base acreage established for individual farms. The producer, however, will have the privilege of reducing to a maximum of 45 per cent. below his base acreage. A single adjustment payment of not less than 5 cents per pound on the average yield of lint cotton on the land withheld from production under contract will be made for 1936. The division of payments between landlords and tenants on a farm under contract will be on the following basis: 37½ per cent. to the person furnishing the land; 12 per cent. to the individual furnishing the work stock and equipment, and a division of the remaining 50 per cent. in the proportion that the cotton or its proceeds is divided. Contract signers agree, in so far as is economically practicable, to keep the number of tenants or share croppers that were kept the preceding year, and to allow them the percentage of land which they had in cotton in 1935. The adjusted acres may be used for the production of food and feed for consumption on the farm, but the customary acreage on the farm growing crops for sale must not be increased.

220. AMERICAN UNIVERSAL COTTON STANDARDS. (*Int. Cott. Bull.*, xiv., 52, 1935, p. 37.) Revision of the United States official standards for cotton grades has been proposed by the Bureau of Agricultural Economics, with a view to making the white grades more representative of the cotton crop. Changes in the colour of the crop in recent years have been towards white cotton.

221. THE NEW CO-ORDINATED FEDERAL STATE COTTON RESEARCH PROGRAMME. By H. W. Barre. (*Int. Cott. Bull.*, xiv., 54, 1936, p. 169.) The author of this paper—who is Principal Pathologist in Charge of the Division of Cotton and Other Fibre Crops and Diseases, Dept. of Agriculture, Washington, D.C.—states that “the United States Department of Agriculture has for several years been working towards a co-ordinated cotton research programme. Last February these efforts took definite shape in the form of a preliminary report published in mimeographed form, and made available to those interested in and participating in the programme. This statement reports in some detail the researches needed and planned in such fields as cotton breeding and genetics, botany, and morphology and development of cotton, physiology and nutrition in relation to quality and yields, cotton diseases and insect control, fertility and cultural problems, as well as researches in ginning, preparation for market, fibre analysis in relation to utilization, cotton utilization in broader senses, competition and demand, world changes in production, consumption and price, marketing and financing. These researches concerning all aspects of cotton production, utilization and marketing, are conducted throughout the Cotton Belt in co-operation with the State Agricultural College and Experiment Stations and in Washington. Altogether they constitute a very comprehensive programme of research, looking to the improvement of the quality of the cotton and to the strengthening of the position of the crop in world demand and trade.”

The part taken in this programme by the author's own Division is then discussed, and an account is given of the researches conducted by the Division, in co-operation with the State Agricultural Experiment Stations, “designed to measure some of the specific properties of cotton fibres, and to determine the physical and biological factors responsible for the presence or absence of or for the variations in these properties.”

222. RESEARCH IN THE UNITED STATES. By H. D. W. Smith. (*M/c. Guar. Coml. World Textiles Number*, 1935, p. 21.) A brief survey of the research work now in progress in the various institutes and foundations for textile research in the United States.

223. UNITED STATES INSTITUTE FOR TEXTILE RESEARCH: ACTIVITIES. By H. D. W. Smith. (*Amer. Dyes Rpt.*, 24, 1935, p. 513. From *Summ. of Curr. Lit.*, xv., 24, 1935, p. 658.) An account is given of the functions, development, and activities of the United States Institute for Textile Research and its official journal *Textile Research*. Reference is made to the present programme of warp research, the purpose of which is to obtain information on such questions as the correct viscosity of size mixtures, the value of softeners, the relation between the properties of the warp yarn and the properties of the size coating, etc.

224. FLORIDA: Field Crops Research. (*Florida Sta. Rpt.*, 1934. From *Exp. Sta. Rec.*, 73, 2, 1935, p. 169.) Included fertilizer experiments, and crop rotation studies with corn, cotton, crotalaria, and Austrian winter peas.

225. NEW MEXICO: Agronomic Experiments. (*New Mexico Sta. Rpt.*, 1934. From *Exp. Sta. Rec.*, 73, 2, 1935, p. 170.) The research work included varieta! breeding and fertilizer experiments with cotton.

226. TENNESSEE: Field Crops Experiments. By H. P. Ogden *et al.* (*Tennessee Sta. Rpt.*, 1933. From *Exp. Sta. Rec.*, 73, 2, 1935, p. 171.) The work with cotton included breeding, cultural, and fertilizer tests, and studies of varietal differences in relation to weather conditions, earliness, shodding, and other factors.

COTTON IN FOREIGN COUNTRIES.

227. BRAZILIAN COTTON PRODUCTION. By L. Nigra. (*Indus. Text.*, iv., 40, 1935, p. 5. From *J. Text. Inst.*, xxvi., 12, 1935, A652.) There was a considerable increase in production in 1934, and the distribution of the crop according to staple length is shown. The greater part of the Brazilian crop has a staple length of 28-29 mm. The amount available for export, and the influence of conditions in North America on the Brazilian cotton market, are briefly discussed.

228. BRAZILIAN COTTON: PRODUCTION. By C. L. Jones. (*Text. World*, 85, 1935, p. 2035. From *Summ. of Curr. Lit.*, xv., 23, 1935, p. 611.) Brazil has much suitable land for cotton growing, but the chief handicaps are lack of efficient transport and unsatisfactory labour. Given, however, a stable efficient government, and an outside demand for cotton at a steady price level, there is no reason why Brazil should not so improve labour conditions, transportation, machinery, methods, etc., that she can market 8,000,000 bales yearly, a quantity equal to the exports from the U.S.A.

229. COTTON PRODUCTION IN NORTH-EAST BRAZIL. By P. K. Norris. (*F.S. 64. U.S. Dpt. of Agr., Bur. of Agr. Econ.*, Washington, D.C., 1935.) The total area of the states of North-East Brazil is estimated at 1,133,253 square miles, but only a small percentage is potential cotton land. Much of the area is in forest, jungle, desert, and waste land uninhabited and uninhabitable. Cotton is grown mainly in the coastal plain, the low foothills and coastal mountains, and the interior plateau beyond the coastal mountains. American Upland is cultivated in the coastal plain and foothills, and the Brazilian tree cotton in the interior plateau.

The history of cotton production in North-East Brazil is marked by periods of high production followed by periods of decline in some cases to a negligible point. The present high production is due largely to the favourable weather conditions of the past few seasons, but in view of the many factors limiting cotton cultivation in this area—periodical droughts, inadequate transport facilities, labour shortage, lack of credit facilities, etc.—it is expected that there will be some falling-off in production in the next few years.

230. COTTON PROSPECTS IN NORTH CHINA. (*Int. Cott. Bull.*, xiv., 52, 1935, p. 26.) An interesting review of the situation, with figures of acreage and production for the different provinces.

231. FRENCH COTTON INDUSTRY: ECONOMICS. By M. Mieg. (*Bull. Soc. Ind. Mulhouse*, 101, 1935, p. 391. From *Summ. of Curr. Lit.*, xv., 22, 1935, p. 610.) The measures proposed at various times for the improvement—through the establishment of a minimum price and, more particularly, the reduction of production—of the French cotton spinning industry are discussed. Up to the present these have never been put into effect in their entirety, as there has always been opposition from at least 25 to 30 per cent. of those concerned. Even if the projected law authorizing a certain measure of control is put into operation, it is doubtful if it will effect a stabilization of the industry.

232. GERMAN TEXTILE RESEARCH INSTITUTE, DRESDEN: ORGANIZATION AND EQUIPMENT. By W. Schramek. (*Leipz. Monats. Text. Ind.*, 50, 1935, p. 64.

From *J. Text. Inst.*, xxvi., 11, 1935, A604.) The Institute, which was founded in 1918, has in recent years experienced financial difficulties owing to the depression in the textile industry. The possibilities of acquiring modern equipment and of increasing the staff have been strictly limited, and there has been a tendency to neglect fundamental research and pay more attention to testing and special enquiries from the industry. The author, who was appointed Director in 1934, discusses briefly the relations between research and special enquiries in such an establishment, and describes the reorganization of the Institute which he has carried out so that both these functions of a research institute may be fulfilled satisfactorily. Photographs of the Institute, the chemical laboratory, microscopy room X-ray equipment and the library are included, and the equipment and work are briefly discussed.

233. JAPAN: CENTRAL COTTON COUNCIL. (*Int. Cott. Bull.*, xiv., 52, 1935, p. 98.) A Central Cotton Council has been formed composed of representatives of the Japan Cotton Spinners' Association, the Japan Federation of Export Cotton Textiles Industrial Associations, and the Export Cotton Yarn and Textile Dealers' Association. Its object is to promote understanding among these three major bodies and the spinners, weavers, and exporters, with the view to further expansion of Japan's cotton industry. The other two bodies are, however, not in agreement with the suggestion of the Japan Cotton Spinners' Association to invest the new Central Cotton Council with legislative powers.

234. INFORME DEL VIAJE DE ESTUDIO PRELIMINAR REALIZADO EN LOS VALLES DEL NORTE PARA LA CREACION DE UNA SUB-ESTACION EXPERIMENTAL DE ALGODON. By J. Paez. (*Informe No. 29, 1935. Estacion Exp. Agr. de La Molina, Lima, Peru.*) A profusely illustrated account of a visit to the valleys of Northern Peru to investigate their suitability for the establishment of a new experiment station for cotton, and the estimated cost of such a station.

235. COTTON CULTIVATION IN THE UKRAINE. (*Int. Cott. Bull.*, xiv., 52, 1935, p. 24.) Much success is recorded for the five years since the industry started. This year 156,000 hectares are under cotton, the yield being estimated to average between 1.1 and 1.8 tons per hectare.

236. COTTON CULTIVATION IN SENEGAL. (*Fils et Tissus*, 23, 1935, p. 717. From *Summ. of Curr. Lit.*, xv., 23, 1935, p. 611.) Attempts to develop cotton cultivation in Senegal are reviewed, and a plea is made for a renewal of interest. Encouraging results obtained with various American varieties and hybrids at the agricultural stations at Segou and Sokolo are described.

237. TURKISH TEXTILE INDUSTRY: DEVELOPMENT. (*Leipz. Woch. Text. Ind.*, 50, 1935, p. 246. From *J. Text. Inst.*, xxvi., 8, 1935, A439.) The total number of spindles has increased from 72,000 in 1931 to 162,000 in 1935, and according to the five-year plan the figure should increase to 231,900 in 1937. The number of looms was 1,620 in 1934, and should reach 4,680 in 1937. The production of cotton yarns increased from 1,477,800 kg. in 1927 to 6,650,000 kg. in 1934. Owing to the growth of the textile industry the amount of Turkish cotton available for export has declined.

SOILS AND MANURES.

238. THE IMPERIAL BUREAU OF SOIL SCIENCE, HARPENDEN, ENGLAND. We have received a copy of a pamphlet dealing with the many activities of the Bureau, which exists primarily to assist research workers in the important task of keeping abreast of new literature on soil and related sciences. The Bureau keeps a classified and annotated index of nearly all the papers dealing with soils and fertilizers published throughout the world. Abstracts are made

of the papers seen, and monthly lists of these are issued to all interested research workers and institutes in the Empire. A large number of enquiries on scientific and technical matters are dealt with every year, and in addition the Bureau undertakes translations from the numerous European languages in which some of the most important scientific papers are now written. A list of the publications issued by the Bureau is included.

239. BIOLOGICAL PROCESSES IN TROPICAL SOILS. By A. Steven Corbet. (Pubd. Heffer & Sons, Cambridge, 1935. Price 7s. 6d. Reviewed *Trop. Agriculture*, xii., 11, 1935, p. 303.) A book written primarily for agricultural chemists working in tropical countries. The author has confined his observations mainly to Malaysia, but this country is typical of many parts of the tropics, and thus the general title of the book is justified. A point of prime importance which is emphasized throughout is the application of Jenny's Law to tropical soils, and a soil temperature of 25° C. is shown to be the critical point, above which accumulation of organic matter cannot take place. The author has applied this to the nitrogen cycle, and has pointed out that it is useless to attempt to obtain a permanent increase in soil nitrogen in a cleared area where the effect of removing the forest cover has been to raise the soil temperature above this critical point. This is of the utmost importance in many tropical crops, since it means that frequent light applications of nitrogenous fertilizers constitute the most economical method of raising the nitrogen status of the plants. Agricultural chemists will find the book of great interest and value.

240. A NEW INSTRUMENT FOR SOIL SAMPLING. By A. Lödöesöl. (*Soil Sci.*, 39, 4, 1935, p. 257. From *Exp. Sta. Rec.*, 73, 3, 1935, p. 302.) The sampler described and illustrated is of brass tubing having an internal diameter of 7.98 cm. and an internal height of 20 cm. from the cutting edge to the inner face of the removable endpiece, so that its capacity is exactly 1 litre. A lever attachable to the handle of the endpiece provides for the application of additional force if this is necessary to drive the sampler into the soil. An exactly fitting hollow copper plunger is used to force the sample out of the cutting tube. A cap for the cutting end permits holding the sample in the instrument without loss of soil or moisture, but tins with a spring catch or rubber bags are the recommended means for transporting the samples to the laboratory. Line drawings and a half-tone plate show the construction of the instrument and its appearance as a whole. The full-sized sampler is designed primarily for organic soils. For hard and stony soils the author recommends an instrument otherwise entirely similar, but made from stainless steel tubing and of an internal diameter of but 3.57 cm., giving it a capacity of 0.2 litre.

241. AN IMPROVEMENT IN THE HYDROMETER METHOD FOR MAKING MECHANICAL ANALYSES OF SOILS. By G. J. Bouyoucos. (*J. Amer. Soc. Agron.*, 27, 4, 1935, p. 319. From *Exp. Sta. Rec.*, 73, 3, 1935, p. 302.) The author of this note from the Michigan Experiment Station has improved his hydrometer method by providing for the breaking of the froth, which has heretofore caused inconvenience in the reading of the hydrometer, at the end of the first forty seconds of settling, the observation having been made that a drop either of ether or of one of the higher alcohols (preferably amyl alcohol) eliminates almost instantly an otherwise persistent foam.

[Cf. Abstrs. 295, Vol. IV., and 366 and 367, Vol. VI. of this Review.]

242. A SIMPLER METHOD OF EXPRESSING THE MECHANICAL ANALYSIS OF MANY COMMON SOILS. By R. L. James. (*Soil Sci.*, 39, 4, 1935, p. 271. From *Exp. Sta. Rec.*, 73, 3, 1935, p. 302.) In a contribution from the Canterbury Agricultural College, New Zealand, the author reports the observation that the plotting

of percentage of soil material left in suspension against time of hydrometer reading yields a smooth curve, and that by plotting the logarithms of the percentage in suspension and of the time a straight line, in each case characteristic of the soil in question, is obtained. He therefore proposes to express the mechanical analysis of soils as the percentage of material in suspension after one minute ("fine material"), and the slope of the straight line ("settling rate"), and notes that "from these two numbers the straight line can be reproduced at any time, and the amount of fine silt, coarse clay, etc., can be read off."

243. THE AMMONIUM CARBONATE METHOD OF DISPERSING SOILS FOR MECHANICAL ANALYSIS. By A. N. Puri. (*Soil Sci.*, 39, 4, 1935, p. 263. From *Exp. Sta. Rec.*, 73, 3, 1935, p. 302.) The procedure consists in boiling the soil with an ammonium carbonate solution, and continuing the boiling after the addition of some sodium hydroxide or lithium hydroxide. The method has been shown to give maximum dispersion with all types of soils, including laterite and humus. This method "cannot be called too drastic, since boiling is already a standard procedure in the International method. The author has attempted to include all types of soils available, but the possibility of others presenting peculiar difficulties is not remote. The ideal method that would succeed with all types of soils (and of soil scientists) may still await discovery, but the present method seems to be a step in the right direction."

244. THE MECHANICAL ANALYSIS OF LATERITIC SOILS. II. A NOTE ON THE APPLICABILITY OF THE HYPOBROMITE METHOD. By J. N. Chakraborty and A. Sen. (*Ind. J. Agr. Sci.*, v., 1, 1935, p. 39.) The results of experiments indicate that the dispersion of Indian lateritic soils by the hypobromite method is incomplete without the addition of a sufficient quantity of alkali so that pH of the final suspension is 10.5. A better dispersion of soils is also obtained by including the standard shaking procedure extending over twenty-four hours in the hypobromite method. An objection to the method is that it requires the use of large quantities of obnoxious and injurious chemicals such as bromine and ammonia, which renders it unsuitable for use in routine practice.

245. THE MECHANICAL ANALYSIS OF LATERITIC SOILS. III. A NEW METHOD USING ALKALINE PERMANGANATE FOR OXIDATION OF ORGANIC MATTER. By J. N. Chakraborty. (*Ind. J. Agr. Sci.*, v., 1, 1935, p. 41.) Alkaline permanganate is stated to be more suitable than hydrogen peroxide in temperate and tropical countries. It can be used in manganiferous soils, and is much cheaper than either hydrogen peroxide or sodium hypobromite. The time required for oxidation does not exceed three hours even in soils containing large quantities of organic matter (e.g., 10 per cent.), whereas hydrogen peroxide and sodium hypobromite require much longer time. The use of injurious chemicals like bromine, as in the hypobromite methods, is unnecessary.

246. SOIL PROBLEMS IN THE SUDAN. By H. Greenc. (*Trans. of 3rd Int. Cong. of Soil Sci.*, i., 1935.) In a series of papers entitled "Böden des Nil und Gash," Vageler and Alten have presented, in conjunction with their own valuable data, a friendly and appreciative account of soil investigations carried out in the Sudan. The conclusions which they reached differ in some important respects from those which the writer believes to be correct, and the data on the subject are therefore reviewed to remove any misunderstandings that may have arisen. Summaries are included (a) of soil investigations carried out in the Sudan during the twenty years that preceded erection of the Sennar Dam, (b) of more recent work and problems now under study, and (c) of reasons for rejecting some opinions formed by Vageler and Alten.

247. THE EFFECT OF IRRIGATION AND DRY FALLOW ON A HEAVY, BASE SATURATED SOIL. By H. Greene and O. W. Snow. (*Trans. of 3rd Int. Cong. of Soil Sci.*, i., 1935.) Deals with the subject under the following heads: Gezira soil a base saturated colloid; Fertility and field characteristics of the soil; Review of laboratory observations; Practical aspect of the investigations; Hydrolysis of the clay-base compound; Aggregation of clay particles not wholly dependent on exchangeable bases.

248. THE MOISTURE CONTENT OF IRRIGATED COTTON PLOTS. By H. Greene and O. W. Snow. (*Trans. of 3rd Int. Cong. of Soil Sci.*, i., 1935.) A comparison of the Gezira and the Gash Delta in respect to irrigation, soil and climate, soil moisture, and the water requirement of Egyptian cotton.

249. THE INFLUENCE OF RAINFALL ON THE YIELD OF COTTON. By S. N. Venkataraman. (*Assoc. Econ. Biol., Coimbatore, Proc.* 1 [1930-33], p. 3. From *Exp. Sta. Rec.*, 73, 4, 1935, p. 443.) From a quantitative study of the effect of the amount and distribution of rainfall, seasonally and through a period of twenty years, on the yield of cotton at Coimbatore, Madras, the conclusion was drawn that "extra rain tended to reduce the yield in a greater part of the year, and more particularly in the months of July-August, and this effect was more pronounced in cotton after cumbu (*Pennisetum typhoideum*) than in cotton after cholam (*Andropogon sorghum*)."

250. INVESTIGATIONS INTO THE WATER REQUIREMENT OF CROP PLANTS. By B. N., R. B., and K. Singh. (*Ind. Acad. Sci., Proc. I.*, Sect. B, 9, 1935, p. 471. From *Exp. Sta. Rec.*, 73, 4, 1935, p. 466.) Studies at Benares Hindu University Institute of Agricultural Research involving varieties of wheat (4), rice (9), cotton (16), sugar-cane (21) types, tobacco, potatoes, etc., showed the minimum water requirement per acre both for transpiration and soil evaporation, to vary greatly with different crops. Sugar-cane required 45 acre-in., tobacco 30.1, cotton 28.3, rice 27.4, potatoes 20.4, wheat 8.5 acre-in. of water for the whole life cycle.

251. ORGANIC MANURES. By S. H. Jenkins. (*Tech. Commn. No. 33.* Pubd. by the Imperial Bureau of Soil Science, Rothamsted Exp. Sta., Harpenden, 1935. Price 2s. post free.) A valuable review of the subject. The various sections deal with the materials available as organic manures; availability of nitrogen in farmyard manure; comparisons between yields with farmyard manure and with artificials; Edelmist and cold manure; synthetic or artificial farmyard manure; green manures; other organic manures—poultry, guano and rape cake, blood and tankage, fish meal, sewage and sewage sludge; biochemical and microbiological changes occurring during the fermentation of manures; organic manures in relation to soil organic matter, and their influence on the physical properties of the soil; the availability of phosphorus and potassium in organic manures; the influence of organic matter on plant growth and the vitamin content of plants. A list of 155 references to the literature on the subject is included.

252. THE EFFECT OF CALCIUM ON THE GROWTH OF TRANSPLANTED COTTON ROOTS. By V. Novikov. (*Bull. No. 2 of the Cent. Asia Sci. Res. Cott. Inst., Sredaz NIHI*, Tashkent, 1934.) (In Russian, with summary in English.) It was found that CaSO_4 and CaHPO_4 increased the formation and growth of roots of transplanted cotton plants.

253. THE VALUE OF GYPSUM AS A SUPPLEMENT TO A CONCENTRATED FERTILIZER. By L. G. Willis. (*N. Car. Sta. Bull.*, 299, 1934. From *Exp. Sta. Rec.*, 73, 1, 1935, p. 20.) In addition to its stated subject, this bulletin deals with root injury caused by concentrated fertilizers.

Small quantities of gypsum added to a concentrated fertilizer brought its efficiency up to that of the materials more commonly used. It appears that ordinary fertilizers may provide more gypsum than is needed when used in large applications, thus increasing the leaching loss of potassium and magnesium.

"Ground limestone does not immediately prevent the injury caused by the concentrated fertilizer. . . . The calcium- and sulphur-free concentrated fertilizer produced cotton crops equal to those produced with ordinary fertilizers on soils previously receiving heavy applications of the latter. . . . On depleted soils, low yields with concentrated fertilizers are associated with root injury caused by some ingredient of the fertilizer, probably the ammonium compounds. This injury is not systematic. The low yields may result from interference with the absorption of normal supplies of water or nutrients supplied by the soil."

254. FERTILIZATION OF COTTON IN A CROP ROTATION SYSTEM. By D. W. Kharkov. (*Bull. No. 1 of Cent. Asia Sci. Res. Cott. Inst. Sredaz NIHI*, Tashkent, 1934.) (In Russian, with summary in English.) Deals with the types of fertilizers, the optimal time of application, and the residual effect in subsequent years.

255. ADAPTATION OF FERTILIZERS FOR COTTON SOILS. By O. Schreiner and J. J. Skinner. (*Amer. Fert.*, 81, 12, 1934, p. 5. From *Exp. Sta. Rec.*, 73, 3, 1935, p. 313.) In this discussion of the adaptations of fertilizer composition and proportions of plant foods to meet the requirements of cotton soils, experiments by the U.S. Dept. of Agriculture and State Experiment Stations in the South, sometimes in co-operation, are cited to show that inorganic sources of nitrogen may be as effective for cotton production as higher-priced organic ammoniates, thus effectively reducing the fertilizer cost to the consumer. Delayed nitrogen fertilizer applications appear not to be more efficient than full applications in the fertilizer at planting time, thus providing further economies in farm labour. Properly blended fertilizer salts, together with basic materials in the preparation of concentrated fertilizers, avoiding high acidity equivalents, may be as efficient on cotton soils as ordinary fertilizers, but at a lower cost for equivalent plant food.

256. THE MENACE OF SOIL EROSION. (*W. Ind. Comm. Circ.*, L. 968, 1935, p. 453.) From an article on "Soil Erosion Studies" in the U.S.A. Dpt. of Agr. Yearbook, 1934, we learn that in an area where the annual rainfall was just under thirty-three inches it was determined by accurate measurements that from an acre of land covered with Bermuda or Devil Grass the amount of soil removed by rain in a year was 0.04 tons; from an acre of bare soil uncultivated, 14.59 tons; and from an acre of land under continuous cotton, 28.05 tons. In another case, whilst the loss under a grass cover remained very low, the cotton land lost 61 tons of soil a year and the bare uncultivated land 112 tons.

257. THE INFILTRATION CAPACITY OF SOILS IN RELATION TO THE CONTROL OF SURFACE RUN-OFF AND EROSION. By G. W. Musgrave. (*J. Amer. Soc. Agron.*, 27, 5, 1935, p. 336. From *Exp. Sta. Rec.*, 73, 4, 1935, p. 446.) Pointing out that the amount of erosion occurring from a field for a rain of given intensity and duration may be approximately predetermined for a given set of conditions if quantitative data are available for (1) amount of water impounded upon the surface of the field by the treatment, (2) the rate of infiltration for the soil and conditions, and (3) the density of the run-off (lbs. of soil per cubic foot of run-off) for the soil and the treatment, the author shows from data obtained at the Iowa and Missouri erosion experiment stations of the U.S.D.A. Bureau of Chemistry and Soils, that the amount of water impounded by such treatments as terracing, contouring, etc., is approximately determinable, methods and specific cases of the measurement of the infiltration capacity of field soils being given.

"Before erosion control measures are designed and recommended for general application in the field, their probable effect should first be calculated, and the degree of protection which they afford compared with the rainfall records of the area."

258. SOIL EROSION AND ITS PREVENTION. Compiled by D. Graf. (*U.S. Dept. Agr., Bur. Agr. Engin.*, 1935. From *Exp. Sta. Rec.*, 73, 4, 1935, p. 548.) This is a partial (mimeographed) list of references on the subject from 1900 to 1934.

259. EROSION AND TERRACING. (*Porto Rico Sta. Rpt.*, 1934. From *Exp. Sta. Rec.*, 73, 4, 1935, p. 549.) Progress results of experiments on the protection of terrace banks against erosion by planting with *Cordyline guineensis* are briefly presented.

260. SOIL EROSION IN MISSOURI. By L. D. Bayer. (*Missouri Sta. Bull.* 349, 1935, p. 66. From *Exp. Sta. Rec.*, 73, 4, 1935, p. 549.) It is the purpose of this report to (1) present the picture of the seriousness of erosion in the various soil areas of the State as it now exists, (2) call attention to the factors that have contributed to soil losses by erosion, and (3) suggest possible means of controlling erosion most effectively throughout the various sections of the State in accordance with the properties of the soils.

261. ENGINEERING EXPERIMENTS IN SOIL EROSION CONTROL IN THE NORTH-WEST. By P. C. McGrew. (*Agr. Eng.*, 16, 5, 1935, p. 187. From *Exp. Sta. Rec.*, 73, 5, 1935, p. 695.) In a brief contribution from the U.S.D.A. Bureau of Agricultural Engineering the engineering experiments used in connection with the development of soil erosion control methods in Oregon, Washington, and Idaho are briefly described.

262. RESULTS OF RECENT ENGINEERING STUDIES IN SOIL EROSION CONTROL. By F. O. Bartel. (*Agr. Eng.*, 16, 8, 1935, p. 304. From *Exp. Sta. Rec.*, 73, 5, 1935, p. 694.) In a contribution from the U.S.D.A. Soil Conservation Service the results of studies conducted on the Central Piedmont Soil Erosion Farm at Statesville, N.C., are presented and discussed. The studies include investigations of rates of soil and water losses from terraced and unterraced land; the effect of differences in land slopes and soil conditions upon such losses; the most practical grade, height, spacing, and shape of terraces; the cost of terrace construction, terrace maintenance, and cultivating terraced lands; the proper method of laying off crop rows; the economical use and development of farm machinery, and other problems relating to terraces and their use. The construction of check dams and soil-saving dams, the control and reclamation of gullied land, the effect of subsoiling eroded soil, and the study of moisture losses and crop yields are phases of the engineering studies projected or under way. The most fundamental of all of these investigations is the determination of the comparative soil and water losses from unterraced, terraced, and wooded areas.

In spite of more favourable conditions of soil and slope and heavier crop cover, the unterraced area lost 8.5 times as much soil during 1932 as did the terraced area. In 1933 the unterraced area lost ten times as much soil, and the total run-off was 48 per cent. greater and the maximum rate of run-off attained was almost five times as much.

CULTIVATION, IRRIGATION, GINNING, ETC.

263. EXPERIMENTAL METHOD: APPLICATIONS OF THE ANALYSIS OF VARIANCE IN EXPERIMENTAL ARRANGEMENT. By L. C. McCleery. (*J. Aust. Inst. Agr. Sci.*, i., 1935, p. 96. From *Pl. Bre. Absts.*, vi., 2, 1936, p. 101.) A brief survey of the applications of Fisher's Analysis of Variance, and some of its modifications.

264. STUDIES IN THE TECHNIQUE OF FIELD EXPERIMENTS, I., II. and III. By J. B. Hutchinson and V. G. Panse. (*Ind. J. Agr. Sci.*, 1935, v., 4, p. 523; v., 5, pp. 545 and 554.) I. SIZE, SHAPE AND ARRANGEMENT OF PLOTS IN COTTON TRIALS. The results of a uniformity trial with Malvi cotton at Indore are reported. Standard error per cent. per plot decreased steadily with increasing plot size. For any given plot size standard error per cent. per plot decreased steadily as the length of the plot (along the rows) was increased. The advantage of long, narrow plots laid out along the rows over plots of the same size and shape laid out across the rows is shown to be independent of fertility gradient, and it is suggested that it is associated with the method of sowing. It is shown that approximately square blocks eliminate more of the soil heterogeneity than rectangular ones. With blocks of $\frac{1}{25}$ acre or larger, shape is the most important factor in determining efficiency. A Latin square lay-out has no advantage over an efficiently designed randomized block lay-out with the same number of plots. Optimum lay-outs for different types of experimentations are discussed, and a table is given to facilitate determination of the amount of land and number of replications required for a given accuracy with different plot sizes.

II. SAMPLING FOR STAPLE-LENGTH DETERMINATION IN COTTON TRIALS, WITH A NOTE ON THE STANDARD ERROR OF ESTIMATES OF GINNING PERCENTAGE. Information was collected on halo-length, plot by plot, in replicated variety trials. Combing was done by girls trained for the purpose, and measurements were made by skilled observers. Similar data were collected on halo-lengths of single plants. Combing was done by the same girls, but some sets of measurements were made by semi-skilled laboratory assistants. It is shown that with skilled observers, five measurements per plot, or per plant, are adequate to give a standard error of the mean of 0.5 mm. Laboratory assistants varied greatly in their efficiency as measured by the standard error of the means of their observations, indicating the necessity of careful training and periodical checking of such subordinate staff. In replicated plot trials with measurements by skilled observers, within-plot variation was responsible for only a small proportion of the error variance. Sampling for staple-length measurement should therefore be plot-wise, and not from the pooled product of all plots of a variety.

Where it is not possible to gin plot yields separately, the data here presented suggest that, provided the experiment was not carried out on very uneven land, a difference in ginning outturn of 1 per cent. may be regarded with some confidence as real.

III. AN APPLICATION OF THE METHOD OF COVARIANCE TO SELECTION FOR DISEASE RESISTANCE IN COTTON. An experiment in an investigation of the resistance of cotton strains to root-rot disease is described in which alternate rows of all plots were sown with a uniform control strain. Details are given of the application of the method of covariance to data obtained. The error variance was in general reduced to about one-half by adjustment for the covariance of control and variety rows, giving the same advantage as would be obtained by doubling the number of plots. The scope and advantages of the method are briefly discussed.

265. STUDIES OF THE SAMPLING TECHNIQUE IN COTTON EXPERIMENTS. I. SAMPLING FROM LOCKS. By K. S. Cheng *et al.* (In Chinese, with summary in English.) (*Bull. No. 2, Kwangsi Agr. Exp. Sta.*, Liuchow, Kwangsi, China, 1935.) Differences in certain seed and lint characters from seeds located in different parts of the lock were shown to be both consistent and significant, similar results being obtained for both Chinese and American cottons. In a study of the lint length of 7-seed locks of Chinese cottons, lint on seeds 2 and 6 was decidedly longer than that on the other seeds; seed 4 had the shortest lint. In the 9-seed locks of

American cotton, seeds 3, 4, 6 and 7 were found to have the longest, and seed 5 the shortest lint. Locks with fewer seeds appeared to be higher in their weights of seed and lint.

The systematic method of sampling is not recommended, the authors stating that the random method gives universally better results and is more accurate from a statistical view-point. The random method takes slightly more time, but it is suggested that this difficulty may to some extent be overcome by the use of a table of random sampling numbers by Tippett.

266. OM VARIATIONSANALYSE, I., II. and III. By R. K. Kristensen. (*Tidsskr. Planteavl*, vol. xxxix.-xl., 1933-35. From *Pl. Bre. Absts.*, vi., 2, 1936, p. 127.) The author compares R. A. Fisher's method of analysis of variance with his own elimination method.

267. VERNALIZATION, LYSENKO'S YAROVIZATION OF SEED. By P. S. Hudson. (*Proc. 6th Int. Bot. Congr.*, Amsterdam, 1935, 2, p. 20. From *Pl. Bre. Absts.*, vi., 2, 1936, p. 140.) An account of the underlying principles of vernalization.

268. ALGUMAS CONSIDERACOES SOBRE OS FUNDAMENTOS CIENTIFICOS DA VERNALISACAO OU IAROVISACAO. By J. de C. Vasconcellos. (*Rev. Agr. Lisboa*, 1934, xxii., 2, p. 14. From *Pl. Bre. Absts.*, vi., 2, 1935, p. 140.) The author traces the processes which occur at the time of vernalization, emphasizing the biochemical aspect, on the basis of which he concludes that although the process of germination is retarded by the treatment, the hydrolysis of carbohydrates to sugars proceeds rapidly. This is regarded as one of the probable causes of the greater activity of the plants arising from the vernalized seeds, together with the changed colloidal properties of the protoplasm also brought about by the low temperature.

269. VERNALIZATION OF COTTON IN NEW COTTON REGIONS. By I. A. Ivanisin. (*Bor'ba za Khopok*, No. 10-11, 1934, p. 115. From *Pl. Bre. Absts.*, vi., 2, 1936, p. 141.) The first stage in cotton vernalization is to moisten the seed to 80 per cent. (57 litres water to 100 kg. cotton seed). The moistened seed is left in a heap, whereby the temperature in the heap rises to 23-35° C., under which condition the seed is maintained for 15-20 days. Means are used, including drying, cooling, etc., to prevent more than 1-3 per cent. of seeds germinating, and to avoid the growth of moulds. The results of experiments from 1932-35 show that after vernalization all the main developmental stages are accelerated; germination is accelerated by 2-14 days, flowering by 3-8 days, and maturity by 4-15 days, as a result of which yield is considerably increased. Not infrequent cases of failure in cotton vernalization are partly attributed to inadequate attention to the details of technique.

270. COTTON YIELDS AS INFLUENCED BY ALFALFA. By N. P. Malinkin. (*Bull. No. 1 of Cent. Asia Sci. Res. Cott. Inst., Sredaz NIHI*, Tashkent, 1934.) (In Russian, with summary in English.) On heavy soils and in regions of poor water supply in Central Asia the ploughing under of a crop of alfalfa will effect a considerable increase in the yield of the following cotton crop.

271. FIELD TECHNIQUE WITH THE PLOUGH. By D. D. Paterson. (*Trop. Agriculture*, xii., 11, 1935, p. 287.) Describes in detail some simple ploughing systems which experience has shown to be thoroughly efficient and at the same time, once a field demonstration has been carried out, well within the comprehension of the native farmer or the semi-illiterate mechanic of the tropical zone.

272. CULTIVATOR ATTACHMENTS FOR COTTON CULTIVATION. By L. A. Hadginova. (*Bull. No. 3 of the Cent. Asia Sci. Res. Cott. Inst., Sredaz NIHI*, Tashkent, 1934.) (In Russian, with summary in English.)

273. ALABAMA. THE OLD ROTATION EXPERIMENT. By R. Y. Bailey. (45th *Ann. Rpt. Agr. Exp. Sta. Alabama*, 1934, p. 12.) This experiment, which was started at the Station in 1896, included plots continuously cropped to cotton with and without legumes, a two-year rotation of cotton and corn with legumes, and a three-year rotation of cotton, corn, and oats with legumes. Until 1932 plots 1 and 2 were cropped continuously to corn with legumes grown and turned under on plot 1. The crop on these two plots was changed to cotton in 1932, and the legumes discontinued on plot 1 in order to study the residual value of the legumes turned under during the thirty-five-year period. All plots in the experiment were fertilized uniformly with phosphate and potash.

Average yields for the fourteen-year period, 1920-1933, inclusive, showed that the plot planted continuously to cotton with legumes produced more than twice as much as the plot planted continuously to cotton without legumes. Where legumes were used in the cropping system the average yields of cotton for the two-year rotation of cotton and corn, and the three-year rotation of cotton, corn, and oats, respectively, were 1,060 and 943 lb. of seed cotton per acre. The corn yields for the respective rotations were 21.6 and 22.2 bushels of corn per acre.

A comparison of the yields from plots 1 and 2 over the two-year period, 1932-33, showed that plot 1 produced an average of 1,007 lb. of seed cotton per acre more than plot 2, which had never been planted to legumes. This difference in yield was due to the residual effect of winter legumes.

274. RINGING OF COTTON. By S. Badalov. (*Bull. No. 2 of Cent. Asia Sci. Res. Cott. Inst., Sredaz NIHI*, Tashkent, 1934.) (In Russian, with summary in English.) Ringing, which is said to hasten maturity by 5-9 days, consists in removing a ring 10 mm. broad on the main stem near the soil surface.

275. COTTON PICKING WITH THE "EJECTOR." By S. S. Nikorkin and I. V. Kashinov. (*Bull. No. 3 of Cent. Asia Sci. Res. Cott. Inst., Sredaz NIHI*, Tashkent, 1934.) (In Russian, with summary in English.) A description of the machine.

PESTS, DISEASES, AND INJURIES, AND THEIR CONTROL.

276. ENTOMA: A DIRECTORY OF INSECT PEST CONTROL. Edited by C. C. Hamilton (Plainfield, N.J.: Boise Ptg. Co., 1935. From *Exp. Sta. Rec.*, 73, 5, 1935, p. 647.) This directory, published by the Eastern Branch of the American Association of Economic Entomologists, lists insecticide manufacturers, insecticides, chemicals used in insecticides, insecticide machinery, entomological supplies and equipment, biological testing laboratories, consulting entomologists or chemists, insect pest control companies, etc.

277. LIGHTS FOR LIGHT TRAPS. By E. P. Felt. (*J. Econ. Ent.*, 28, 5, 1935, p. 834.) There is considerable interest in light traps for insect control, and a communication from the Director of Applied Lighting, Westinghouse Lamp Company, calls attention to data necessary for the accurate comparison of different experiments. He states that experimenters operating with different light sources seldom have a sufficiently complete knowledge of the characteristics of the lamp. Comparisons between different coloured lamps, for example, might result in the erroneous conclusion that the effects were the result of colour quality, whereas probably the greater differences were due to varying intensities. In such work it is important to note the total output of luminous flux and perhaps also the visible candle power. In the case of the yellow lamp this may be about 50 per cent. of the uncoloured white lens. A red lamp of the same wattage might have an output of 20 per cent., and the blue lamp might be

as low as 2 per cent. of the clear lamp. This specialist in lights considers it advisable to measure the amount of energy produced in each band of the spectrum and to note carefully the differences between the different qualities of ultra-violet lights. He states that slight changes of temperature or of pressure will change the ultra-violet quality of the average lamp. The newest illuminants in the hot cathode or high intensity mercury or sodium lamps produce broken line spectra which are also quite sensitive to external conditions, and it is impossible to make accurate comparisons of the attractive or repelling power of such lights without a knowledge of the qualitative as well as the quantitative characteristics of the light source.

278. INSECTS INFESTING COTTONSEED MEAL. By T. L. Bissell. (*J. Econ. Ent.*, 28, 5, 1935, p. 835.) Six species of insects were taken during August, 1935, from cottonseed meal stored in burlap bags in barns at the Georgia Experiment Station. There were two lots of meal, one secured about January, and held in a feed barn and stable, and the second secured in July and held in a new building which housed nothing else but chemical fertilizers. The meal was ground and sacked at a local mill. Both lots were of the crop of 1934. The insects included five species of Coleoptera: *Lasioderma serricorne*, Fab., *Sitodrepa panicea*, L., *Tenebroides mauritanicus*, F., *Tribolium confusum*, Duval, and *Attagenus piceus*, Oliv., and one species of Lepidoptera, *Ephestia kuehniella*, Zell. *Tenebroides* and *Attagenus* were found in the larval stages, *Tribolium* in the adult, while *Lasioderma* and *Sitodrepa* were found in larval, pupal and adult stages.

279. REPORT OF THE PRINCIPAL PESTS OBSERVED IN 1931-33 ON THE CHIEF CULTIVATED PLANTS IN THE STATE OF S. PAULO (BRAZIL). By J. Pinto da Fonseca. (In Portuguese.) (*Arch. Inst. biol.*, 5, p. 263. S. Paulo, 1934. From *Rev. App. Ent.*, xxiii., Ser. A, 7, 1935, p. 364.) The chief cotton pests mentioned are: *Alabama argillacea*, *Platyedra gossypiella*, *Dysdercus ruficollis*, *Aphis gossypii*, *Gasterocercodes gossypii*, and larvæ of *Agriotes* spp. *Hibiscus bifurcatus*, *Rutela lineola*, *Naupactus rivulosus*, *Colaspis* sp., and *Anomis doctorium*.

280. PESTS OF COTTON IN THE PUNJAB, 1933-34. (*Rpt. on Operns. of Dpt. of Agr., Punjab*, 1934.) The cotton white fly develops most actively from May to September, after which it migrates from cotton to its alternative host plants, such as potatoes, turnips, cauliflower, rape and various weeds. From March to May it attacks cultivated cucurbits and ratoon cotton, and then returns to new cotton. In irrigation experiments the attack was in inverse proportion to the quantity of water applied to the crop. Plants treated with nitrogenous manures showed comparatively lower infestation, and the percentage of shed and defective bolls was lowest in plants manured with sodium nitrate and ammonium sulphate. A single spraying with resin soap in July gave a greater yield than one application in August.

Differences in the attack of pink bollworm in various parts of the Punjab were due primarily to differences in temperature acting on both pupæ and adults. The mean temperature in the most important cotton districts is 33° C. (91.4° F.), and pupæ exposed to this or a higher temperature tend to produce sterile males. Lower atmospheric humidity reduced the number of eggs. Hot dry weather from July to October increases sterility in males, reduces oviposition in females, delays emergence of long-cycle moths, and increases mortality in eggs and pupæ.

281. LIST OF INSECT PESTS OF COTTON IN CHOSEN AND OTHER COUNTRIES. By T. Kambe. (In Japanese, with a summary in English.) (*Ann. Agr. Exp. Sta. Chosen*, viii., 4, 1934, p. 359. From *Rev. App. Ent.*, xxiii., Ser. A, 7, 1935.

p. 371.) Very brief notes are given on the feeding habits and seasonal occurrence of forty-five insects that attack cotton in Korea. These include: *Platyedra gossypiella*, *Aphis gossypii*, *Tetranychus telarius*, *Tortrix* (*Cacaecia*) *longicellana*, *Sylepta derogata*, *Agrotis ypsilon*, *Euxoa* (*A.*) *segetum*, *Luperodes quadriguttatus*, *Popillia uchidæ*, and *Maladera* (*Serica*) *orientalis*.

282. A PRELIMINARY STUDY OF THE INSECT PESTS OF COTTON IN THE PHILIPPINES WITH SUGGESTIONS FOR THEIR CONTROL. By F. Q. Otones and F. L. Butac. (*Philipp. J. Agr.*, vi., 2, 1935, p. 147. From *Rev. App. Ent.*, xxiii., Ser. A, 12, 1935, p. 708.) The pests dealt with include *Amorphoidea lata*, *Sylepta derogata*, *Homona* sp., pink bollworm, *Heliothis obsoleta*, *Earias* sp., *Lithocolletis triarcha*, *Dysdercus*, thrips, various species of sucking insects including *Ferrisiana virgata*, *Aphis gossypii*, and *Empoasca flavescens*.

283. A SYSTEM OF CONTROL MEASURES AGAINST PESTS AND DISEASES IN THE COTTON-GROWING REGIONS OF CENTRAL ASIA. By M. J. Kosubutzkii. (In Russian.) (*Plant Prot.*, 2, 1935, p. 35. Leningrad, 1935. From *Rev. App. Ent.*, xxiii., Ser. A, 10, 1935, p. 574.) The recommendations are largely based on investigations of other workers, and are so arranged that individual measures are to supplement each other and are to be applied at definite periods, when the particular pest or disease is most vulnerable.

284. SUDAN: COTTON PESTS, 1933-34. By J. W. Cowland. (*Ann. Rpt. Gezira Agr. Res. Serv.*, 1934. Received 1935.) From the report of the Gezira Entomological Section, we learn that white flies (*Bemisia gossypiperda*) were not as abundant as in the previous season owing to the absence of weeds, especially *Ipomoea cordofana*; infestation was heaviest in the southern blocks. Considerable damage to late sown cotton was caused by thrips, especially on wide spaced cotton and on plants that had received nitrogen. American bollworm (*Heliothis obsoleta*) was present on early sown cotton throughout the Gezira, but a loss of only 20 per cent. of buds was recorded. The percentage of bolls injured by pink bollworm was much higher than for the past five years, and reached 50 per cent. on the Gezira Research Farm. Other pests encountered during the season included jassids, cotton stem-borer, and cotton white ants.

285. COTTON PESTS IN TANGANYIKA, 1934. (*Ann. Rpt. of Dpt. of Agr.*, 1934.) Spiny bollworm (*Earias* sp.) was found to breed on cotton weeds, *Abutilon angulatum* and *A. mauritianum*, and to fly to cotton. The weevil stem-borer *Apion xanthostylum* was observed on Moco cotton. As a result of injury by *Apion* many branches of Moco cotton were broken off in high winds, and the resultant wounds permitted the entry of termites. The weevil damaging the cotyledons has been identified as *Goniorrhinus terrenus*, Mshl. Green bugs, *Nezara* spp. and the Callidea bug, *Callides bohemani*, St., were unusually numerous, and laboratory experiments indicated that they are capable of producing stained locules and preventing completely the opening of bolls. The average percentage of bolls damaged by stainers (*Dysdercus*) was 45.9.

286. OKLAHOMA. THE MORE IMPORTANT INSECT PESTS DURING 1932-34. By E. Hixson. (*Rpt. Agr. Exp. Sta. Okla.*, 1932-34. From *Rev. App. Ent.*, xxiii., Ser. A, 7, 1935, p. 383.) *Aphis gossypii* caused serious injury to cotton when the crop was grown near cowpeas or okra (*Hibiscus esculentus*).

287. SOUTH CAROLINA: COTTON PESTS. (*S. Car. Exp. Sta. Rpt.*, 1933-34. From *Rev. App. Ent.*, xxiii., Ser. A, 11, 1935, p. 657.) It is stated by J. G. Watts that infestation by thrips was much less than in previous years. *Psallus seriatus* was abundant from mid-August to mid-September. The jassids, *Empoasca*

fabæ, Harr., *Graphocephala versuta*, Say, and *Alconeura unipuncta*, Gill., also bred in large numbers on cotton.

288. RELATION OF HOSTS TO ABUNDANCE OF COTTON BOLLWORM. By D. Isely. (*Bull. No. 320, Agr. Exp. Sta. Arkansas, 1935.*) The cotton bollworm, or the corn earworm, is a major pest in Arkansas. An attempt has been made to determine the relation of various hosts to bollworm outbreaks. Corn is the most favourable host. Not only are corn stalks most attractive for oviposition by the moths, but larvæ develop more rapidly on green corn ears than upon any other host. The moths reared from larvæ fed on corn are larger and have a greater fecundity than those reared from other hosts. Legumes grown in combination with corn may extend the breeding season of the bollworm. When reared on green corn ears and at a temperature of 30° C. or above, the bollworm may pass through its immature stages in as short a period as thirty days. Moths reared from worms fed on green corn and kept at 25° C. during their adult lives deposited on an average 1,848 eggs, or more than twice as many as those reared on any other host. Parasitism may be an important check at times on the abundance of the bollworm when it is a leaf feeder.

289. DISPERSAL OF THE PINK BOLLWORM BY FLIGHT OR WIND CARRIAGE OF THE MOTHS. By R. E. McDonald and U. C. Loftin. (*J. Econ. Ent.*, 28, 5, 1935, p. 745.) Information on the dispersal of the pink bollworm by flight or wind carriage of moths was obtained by means of airplane collections, flight screens, trap plots, and wind movement. Moths were taken in airplane collections up to 3,000 feet above ground level, and in large numbers on the flight screens. Some of the trap plots located from twenty-five to sixty-five miles from the nearest cotton became infested late in the season in five of the six years planted.

The prevailing wind is from the heavily infested Laguna district of Mexico toward the United States, and the areas infested in the western part of the United States are in the general direction of the wind currents. The total wind movement in the Laguna during September 1920 to 1931 was closely correlated with the intensity of infestation in Texas. All the indirect evidence indicates that the pink bollworm moths fly or are carried involuntarily by the wind for considerable distances.

290. CORN EARWORM (*Heliothis obsoleta*, FABR.) By R. Veitch. (*Queensland Agr. J.*, xlv., 3, 1935, p. 280.) A general account of the insect and its life history and habits. In addition to cotton, the pest also attacks maize, tobacco, tomatoes, and lucerne. Control measures suggested are early planting, and the elimination of weed hosts such as pig weeds, twin leaf, and wild Cape gooseberry. Experience lends little support in Queensland to the belief that corn earworm in cotton can be successfully and economically controlled by the use of insecticides. The paper is illustrated.

291. CORN EARWORM NOT CONTROLLED IN SWEET CORN BY RELEASE OF *Trichogramma*. By W. H. Larrimer. (*J. Econ. Ent.*, 28, 5, 1935, p. 815.) Experiments showed that the egg parasite, *Trichogramma minutum*, Riley, cannot be utilized in a practical way and on an extensive scale to control the corn earworm (*Heliothis obsoleta*, Fab.) One difficulty appears to be the tendency of the parasite to spread rather slowly from the point of liberation.

292. PRELIMINARY REPORT ON COTTON ROOT APHIDS IN SOUTH CAROLINA. By C. F. Rainwater. (*J. Econ. Ent.*, 28, 5, 1935, p. 755.) Three species of aphids, *Anuraphis maidi-radici*, *Triidaphis phaseoli*, and *Rhopalosiphum* sp., were found injuring the roots of cotton in the Coastal Plains section of South

Carolina in 1934. Notes are given on the distribution, damage, host plants, and biology of the three species.

293. *ÉCOLOGIE DU CRIQUET MAROCAIN EN IRAQ*. By A. Eig. (*Bull. Ent. Res.*, xxvi., 3, 1935, p. 293. From *Rev. App. Ent.*, xxiii., Ser. A, 12, 1935, p. 743.) A study of the vegetation of Iraq in connection with the ecology of *Dociostaurus maroccanus*, Thnb.

294. *ON THE PREFERENDUM IN LOCUSTS*. By I. A. Rubtzov. (In Russian, with a summary in English.) (*Plant Prot.*, 1935, 3, Leningrad, 1935. From *Rev. App. Ent.*, xxiii., Ser. A, 10, 1935, p. 612.) Studies by means of a modified Herter apparatus on temperature preferences in some Siberian Acridids, including *Chorthippus albomarginatus*, DeG., and *Aeropus sibiricus*, L., show that they are very unstable, varying with such factors as age, the preceding physiological state, humidity, light, hunger, etc. At a normal temperature range of between 12 and 38° C. (53-6-104-4° F.), the chief factors determining behaviour, in their order of importance, are humidity, temperature and light, the relative importance of all factors increasing as they approach the limit of their range.

295. *POISON BAIT FOR ERADICATING THE BROWN LOCUST*. By J. C. Faure. (*Farmg. in S. Afr.*, x., 116, 1935, p. 464.) Prepared bait is now issued by the Department of Agriculture. It consists of maize-meal treated in a central factory with the necessary ingredients for making it attractive and poisonous to locusts. It is issued in a dry condition in 100-lb. bags, and in the field only water is added, after which it is broadcast thinly amongst the hoppers. The bait contains 1 per cent. sodium arsenite, and is poisonous to human beings and animals, but there is little danger to animals if it is broadcast very thinly. The new method has been applied in various districts with complete success.

296. *THE ANNUAL CYCLE OF THE DESERT LOCUST (Schistocerca gregaria, FORSK.): ITS MIGRATIONS AND PERIODICITY IN PERSIA AND ADJACENT COUNTRIES OF TROPICAL AND SUB-TROPICAL ASIA*. By S. A. Predtechenskii. (In Russian, with English summary.) (*Bull. Plant. Prot.*, i., 12, Leningrad, 1935. From *Rev. App. Ent.*, xxiii., Ser. A, 10, 1935, p. 582.) The literature on the life-cycle of this locust and its dependence on meteorological factors is reviewed, and the outbreaks in Persia and adjoining countries are described and discussed.

297. *THE LIFE HISTORY OF THE RED LOCUST*. By J. C. Faure. (*Bull. Dpt. Agr. S. Afr.*, No. 144, Pretoria, 1935. From *Rev. App. Ent.*, xxiii., Ser. A, 9, 1935, p. 503.) The previous occurrences of *Nomadacris septemfasciata*, Serv., in South Africa, and the present invasion which began in 1933, are discussed. An account is given of observations on this species. The hoppers and adults of *Nomadacris* were infested by the larvæ of *Blaesoxipha* sp., which did not readily kill the host, and by Gregarines; the adults were parasitized by nematodes of the genus *Mermis*, which did not prevent infested females from ovipositing, and by Trombidiid mites. The mortality from *Empusa grylli* did not exceed 10 per cent. About 5 per cent. of the egg-pods were infested by *Stomatorrhina lunata*, F., and the eggs were also attacked by small unidentified mites. *Wohlfahrtia euvittata*, Villen, occurred in *Nomadacris*, and also in *Schistocerca* and *Locustana*.

298. *THE SPOTTED LOCUST (Aularches miliaris)*. By J. C. Hutson. (*Trop. Agriculturist*, 85, 2, 1935, p. 127. From *Rev. App. Ent.*, xxiii., Ser. A, 11, 1935, p. 638.) Notes are given on the bionomics and control of *Aularches miliaris* in Ceylon.

299. *A GENERAL INVESTIGATION OF THE LOCUST OUTBREAKS IN CHINA DURING 1934*. By F. C. Woo and T. S. Cheng. (In Chinese, with English summary.) (*Spec. Publ. Nat. Agr. Res. Bur. China*, 10, 1935. From *Rev. App. Ent.*, xxiii., Ser. A, 11, 1935, p. 638.) The outbreak of *Locusta migratoria*, L., was less severe

than in 1933. It occurred chiefly in Northern China, and bred mainly on the coasts of the Yellow Sea and the banks of rivers and lakes overgrown with the reed *Phragmites communis*. The bamboo locust *Ceracris kiangsu*, Tsai, was confined to Hunan Province, where for the last two years it has caused serious damage to cereals, palm trees and especially bamboo. A map shows the distribution of species in China in 1934.

300. NOTE SUR LA RÉPARTITION GÉOGRAPHIQUE DE l'*Acridomyia sacharovi*, STACK., PARASITE DE LA *Locusta migratoria*. By E. K. Zolotarev. (In Russian, with a summary in French.) (*Arch. Mus. zool. Univ. Moscou*, i, p. 155. Moscow, 1934. From *Rev. App. Ent.*, xxiii., Ser. A, 11, 1935, p. 633.) *Acridomyia sacharovi*, Stack., a dipterous parasite of *Locusta migratoria*, L., previously recorded only from the Aralo-Caspian area, has been found by the author in the Kuban, North Caucasus.

301. TYPES OF DAMAGE CAUSED TO COTTON PLANT FOLIAGE BY THE RED SPIDER. By I. N. Stepantzev. (In Russian.) (*Plant Prot.*, 1, 1935, p. 119. Leningrad, 1935. From *Rev. App. Ent.*, xxiii., Ser. A, 10, 1935, p. 569.) Variations in the size, colour and situation of the reddish-brown stains caused by the feeding of the red spider (*Tetranychus*) on the leaves of cotton in the Russian Union depend on such factors as the abundance of the mites, the length of the infestations, the condition and variety of the cotton, and the relation between the mites and associated insects. Localized colonies of the mites cause small, sharply defined spots of a bright colour along the edge of the leaves. As their numbers increase, the spots spread over the surface, appearing mostly in places with a tender parenchyma. Where irrigation is insufficient, the mites concentrate on the edges, and infested leaves are bordered with a continuous narrow strip. When thrips are present, the mites usually infest the upper and the thrips the lower tier of the foliage. Leaves infested by thrips do not drop, so that cotton attacked by both thrips and mites yields more than cotton attacked only by mites. Leaves damaged by the thrips become coarse and thick and are therefore rarely infested by the mite. If the mites are destroyed by such predators as *Scymnus* and *Stethorus*, which are very active, the reddish stains gradually disappear and a new green parenchyma begins to grow along the veins, forming a marbled pattern. These leaves do not usually drop, and the plants develop normally. Control measures against the mite, especially with substances that may kill the Coccinellids, should not be carried out on these plants.

302. COTTON DISEASES AND METHODS OF CONTROL. By D. C. Neal and W. W. Gilbert. (*Fmrs.' Bull. U.S. Dpt. Agr.*, 1745, 1935. From *Rev. App. Mycol.*, xiv., 10, 1935, p. 628.) After stating that their observations lead them to believe that disease reduces the American cotton crop by over two million bales a year, the authors give brief popular notes on the symptoms, cause and control of the following major diseases of cotton: root rot, wilt, anthracnose, bacterial blight, rust, crazy top, sore shin, *Ascochyta* blight, and lightning injury. Minor diseases dealt with include: leaf blight, leaf spot, areolate mildew, boll rots, and the true rusts.

303. PLANT DISEASES IN ARIZONA. (*Arizona Sta. Rpt.*, 1934. From *Exp. Sta. Rec.*, 73, 4, 1935, p. 486.) Brief reports are included of progress made in the following, among other, investigations: sulphuric acid treatment of seed for the control of angular leaf spot of cotton; the use of ammonium sulphate and ammonium hydrate for the control of Texas root rot in deciduous orchards; the testing of crop and ornamental plants for resistance to Texas root rot; the inhibition of the cotton root fungus by the fungus *Trichoderma lignorum*.

304. SUDAN: COTTON DISEASES, 1933-34. By R. E. Massey. (*Ann. Rpt. Gezira Agr. Res. Serv.*, 1934. Received 1935.) From the report of the Section of Botany and Plant Pathology we learn that blackarm disease was universal by the end of November, but was only serious where the initial infection had been heavy. The main source of infection of a new crop was found to be the adjacent land on which cotton was grown the previous season.

Leaf curl appeared again during the season, but was not a factor of prime importance in reducing the average yield. The first infected plant was found on October 5, two weeks later than the previous season. This delay in appearance was attributed to the fact that the stumps of the previous cotton crop had been removed bodily from the ground by specially designed tools. This operation was extremely successful in reducing the amount of infected ratoon which was able to survive, and the subsequent spread of the disease was, in consequence, restricted.

The presence of a wilt accompanied by fungal invasion of the root system has been detected towards the end of October for the past ten years in the Gezira, and has caused heavy losses in yield. Research on the subject suggests that certain species of fungi (more especially fungi belonging to the genus *Pythium*) may, through root destruction, be responsible primarily for the poor growth of Sakel in certain seasons. The activity of these fungi may possibly be determined by variations in the weather, notably in the amount of rain which falls either before or after the crop is in the ground. The investigation is being continued.

305. A NEW DISEASE OF COTTON (*GOSSYPIMUM* SP.) IN THE PHILIPPINES. By F. M. Clara. (*Philipp. J. Agr.*, vi., 2, 1935. From *Rev. App. Mycol.*, xiv., 12, 1935, p. 755.) *Helminthosporium* blight produces circular to very irregular, zonate, brown spots of various sizes on the leaves, chiefly the lower ones. Infected tissue may fall, producing a shot-hole effect, and when severely attacked the leaf may be shed. The bracts and bolls are also involved, and badly infected plants are stunted. Control consists in the selection, careful handling, and disinfection of the seed.

306. THE COTTON ROOT ROT FUNGUS, *Phymatotrichum omnivorum*, PARASITIC ON THE WATER-MELON, *Citrullus vulgaris*. By K. D. Butler. (*Phytopathology*, 25, 6, 1935, p. 559. From *Exp. Sta. Rec.*, 73, 5, 1935, p. 635.) Three modes of fungal invasion were noted: (1) direct penetration into a cell, (2) growing between two epidermal cells and finally into a cell, and (3) wedging of several or many hyphae to cause a lesion. Both wedging action and softening of host cell occurred in the initial penetration by the parasite. Within host tissues the fungus hyphae advanced intracellularly as well as intercellularly. Hyphae and haustorium-like bodies grew in direct association with host-cell cytoplasm and nuclei. Also, nuclei of uninvaded cells were less than half the size of nuclei of invaded cells. Inhibitory effects of certain fungi and bacteria on *P. omnivorum* are discussed as possible means of control. Pure-culture studies showed that it is inhibited or killed by the presence of *Trichoderma lignorum*.

307. STUDIES ON THE ROOT-ROT DISEASE OF COTTON IN THE PUNJAB. I. SYMPTOMS, INCIDENCE AND CAUSE OF THE DISEASE. By R. S. Vasudeva. (*Ind. J. Agr. Sci.*, v., 4, 1935, p. 496.) Cotton root rot is a very serious disease in the Punjab, the damage caused being estimated at Rs. 15,75,000 annually. Symptoms of the disease are described. It first appears in June, and continues to be vigorous during July. The attack slows down in August, and almost ceases by the end of September. Experiments showed that *Rhizoctonia solani* and another fungus, provisionally called *Rhizoctonia bataticola*, were the causal organisms.

308. PRINCIPALES ENFERMEDADES DEL ALGODONERO EN EL PERU. By G. G. Rada. (*Rev. App. Mycol.*, xv., 1, 1936, p. 18.) Notes are given in popular terms on the distribution, etiology, symptoms, control, and other features of the cotton diseases in Peru caused by *Fusarium vasinfectum*, *Rhizoctonia* (*Corticium solani*); *Erysiphe malachrae*, *Helminthosporium gossypii*, and *Alternaria tenuis*. In connection with the mode of dissemination of *F. vasinfectum* it is stated that a maximum of 3 per cent. of the spores is seed-borne. Very promising results were given in the control of *C. solani* by seed disinfection with granosan (American ceresan) and ceresan at the rates of 130 and 400 gm. per quintal (50 kg.) respectively. Tanguis cotton appears to be less susceptible to *E. malachrae* than a number of standard varieties from the United States.

309. A MURCHA DO ALGODOEIRO (COTTON WILT). By A. P. Viegas and H. P. Krug. (*Rev. Agr. S. Paulo*, x., 1-2, 1935, p. 49. From *Rev. App. Mycol.*, xiv., 10, 1935, p. 629.) A very brief account of the cotton wilt caused by *Verticillium albo-atrum*, which causes appreciable economic losses to the cotton crop. Work is in hand to control the disease by growing resistant varieties of cotton.

310. TENNESSEE: PLANT DISEASE STUDIES. (*Tennessee Sta. Rpt.*, 1933. From *Exp. Sta. Rec.*, 73, 2, 1935, p. 188.) These include investigations by C. D. Sherbakoff of a new physiologic race of the cotton wilt fungus (*Fusarium vasinfectum*), and selection of cotton strains for resistance to *Verticillium* wilt.

311. A NOTE ON A SURVEY OF THE DISEASE OF MALFORMATION IN THE PUNJAB-AMERICAN COTTONS. By M. Afzal. (*Ind. J. Agr. Sci.*, v., 5, 1935, p. 624.) A brief account of an investigation, financed by the Indian Central Cotton Committee in 1934, of the disease called "Smalling," which first appeared in the Punjab in 1929 on American cotton, and later spread to some of the indigenous varieties. Plants attacked by the disease are stunted in growth, the leaves are mottled and yellow, and the bolls are small and give but few viable seeds. It is not known whether the disease is physiological in character or a virus; its relationship with soil conditions is likewise obscure. Other plants also attacked include lubia, mung, and chillies.

312. STARCH ACCUMULATION IN STENOSIZED COTTON PLANTS. By V. N. Likhite and G. H. Desai. (*Curr. Sci.*, iii., 8, 1935, p. 356. From *Rev. App. Mycol.*, xiv., 8, 1935, p. 507.) Examination of cotton plants growing in Baroda, and affected by stenosis or smalling, showed that on a dry weight basis the leaves contained 17.5 per cent. starch, as against only 11 per cent. for healthy leaves. Starch had also accumulated in the vascular bundles of the petioles and the stems and roots, but not in the healthy branches, of diseased plants.

GENERAL BOTANY, BREEDING, ETC.

313. CONTRIBUTIONS OF BOTANY TO TROPICAL AGRICULTURE. By E. E. Cheesman. (*Trop. Agriculture*, xii., 8, 1935, p. 201.) A good general account of the subject, calling attention to the way in which such comparatively new developments of botany as mycology and breeding upon Mendelian lines have come into use. The value of team work—where this is possible—is stressed.

314. VALUE OF PURE GENETICS TO THE PLANT BREEDER. By J. B. Hutchinson. (*Proc. Ass. Econ. Biol.*, Coimbatore [1934], II., 1935, p. 56. From *Pl. Bre. Absts.*, vi., 2, 1936, p. 102.) The author considers that the reason genetics did not formerly offer more help to plant breeders was that the bias of the earlier workers was away from the statistical aspects. Since geneticists have turned their attention to quantitative characters and to the study of dominance and heterosis the plant breeder has received more aid. Another point in which plant

breeders have received valuable help from genetics is in the utilization of species hybrids—e.g., in cotton, where single characters have been transferred from one species to another.

315. CYTOGENETIC EVOLUTIONARY PROCESSES IN PLANTS. By R. A. Brink. (*Amer. Nat.*, 69, 721, 1935, p. 97. From *Exp. Sta. Rec.*, 73, 5, 1935, p. 595.) Three general classes of cytogenetic processes which have been the objects of considerable study, and which appear to be of significance in evolution—amphidiploidy, changes in chromosome number not involving the whole genom, and structural changes in the chromosome—are discussed. The nature of evidence indicating that the processes have played a rôle in the differentiation of existing species is pointed out, and certain results which detailed experimental analysis of the phenomenon has afforded are reviewed.

316. A NEW POSSIBILITY IN BREEDING. By M. Navashin. (*J. Bot. URSS*, 19, 1934, p. 402. From *Pl. Bre. Absts.*, vi., 1, 1935, p. 33.) The author suggests that artificial parthenogenesis followed by artificial creation of a diploid from the haploid formed is a possible method of creating pure lines, thus avoiding the selection of millions of plants which is necessary under the normal conditions of pedigree breeding. The advantage that would accrue by applying the method to a hybrid showing pronounced heterosis, and so obtaining a homozygous line containing all the dominant yield factors, serves as an example.

317. ON THE ARTICLE OF M. NAVASHIN, "A NEW POSSIBILITY IN BREEDING." By M. A. Bogorodskij. (*J. Bot. URSS*, 19, 1934, p. 409. From *Pl. Bre. Absts.*, vi., 1, 1935, p. 34.) In this criticism the author states that he recognizes the possibilities of the method suggested by Navashin, but points out that the method of bulk sowing followed by selection of homozygotes only in later generations is much simpler than the pedigree method, involves smaller quantities of material and so permits the breeder to work with a larger number of crosses at a time. Various cases of successful application of the bulk population method are instanced, and breeders are urged to give it at least a trial.

318. SURVEY OF WORKS ON POLYPLOIDY AND AMPHIDIPOIDY DURING RECENT YEARS. By A. S. Kasparyan. (*Bull. App. Bot.*, Ser. 2 (6), p. 205, Leningrad, 1934. From *Pl. Bre. Absts.*, vi., 1, 1935, p. 27.) A review of the numerous examples of amphidiploid hybrids now known, and of the most favourable methods of inducing chromosome duplication.

319. THE EFFECT OF GENES ON THE DEVELOPMENT OF SIZE AND FORM. By W. E. Sinnott and F. C. Dunn. (*Biol. Rev.*, 10, 1935, p. 123. From *Pl. Bre. Absts.*, v., 4, 1935, p. 278.) An article directing attention to the importance in genetic research of not neglecting the study of the relationship between the genes and development in animals or plants. The work that has been done on the genic control of size and shape, the problem of the size of parts, genic balance, and correlated growth rates is reviewed. The necessity is emphasized for increasing our knowledge of the developmental processes in material that has been genetically analyzed, as a preliminary to the formulation of generalized principles. There is an extensive bibliography.

320. THE TIME, PLACE, AND ACTION OF CROSSING-OVER. By C. D. Darlington. (*J. Genet.*, xxxi., 1935, p. 185. From *Pl. Bre. Absts.*, vi., 2, 1936, p. 102.) A preliminary brief historical survey is given, and it is pointed out that the mechanisms suggested by Belling to explain crossing-over in cytological terms are unsatisfactory, while most of those suggested by Janassens can now be ignored, since the behaviour of chiasmata has been more completely elucidated. The problem, thus simplified, consists in determining the origin of the chiasma.

321. PLANT PATHOLOGY. (*Nature*, 136 (Suppl.), 1935, p. 386. From *Pl. Bre. Absts.*, vi., 2, 1936, p. 105.) A summary of Mr. F. T. Brooks' address at the British Association Meeting, 1935. Breeding for disease resistant plant forms, and also physiological races of pathogens and their mode of origin, were considered.

322. INHERITANCE OF CERTAIN AGRONOMIC AND MORPHOLOGICAL CHARACTERS IN COTTON. By V. I. Kokuev. (*Sredaz NIHI*, Tashkent, 1935, p. 80. From *Pl. Bre. Absts.*, vi., 2, 1936, p. 176.) The Mendelian ratios expected from crosses involving varying numbers of factor differences are illustrated with reference to cotton, leading to the conclusion that the only successful way to use hybridization in the production of new varieties is to limit the number of parental combinations to the minimum, whilst growing the largest possible number of families of each. In the case of crosses differing in a large number of characters the method of back-crossing is also recommended in order to reduce the number of types segregating.

An examination of the main commercial varieties from the point of view of the individual characters making for quality, namely ginning percentage, lint length, earliness and also size of boll, shows that most of them are intermediate in respect of all these characters, each of which could, if necessary, be increased.

In the present investigations the different characters were considered separately. As regards size of boll, different varieties and strains varied in the proportions of three, four and five bolls they bear; the lines with the greatest number of 5-lock bolls did not, however, possess the largest bolls. The weight of the lock bears a direct relation to the size of the boll, being itself constituted from the number of seeds, their size, and the weight of lint on them.

The size of bolls was studied in a cross between two American cottons, Schroeder (small bolls 3.3-5 g. in weight) and Triumph Navrotskii (large, 8-9 g.). The F_1 was intermediate, though tending more towards the larger parent, with a boll weight of 6.5 g. An F_2 of over 3,000 individuals was grown and contained all types from the largest to the smallest, the distribution being in the form of a regular unimodal curve. The F_2 showed several of the intermediate forms to be homozygous. The experiment thus shows that boll size is dependent on a number of factors, and that desired types can be obtained among the segregates only by growing at least two to three thousand F_2 seedlings.

The Schroeder parent was considerably earlier in maturity than the other, but some of the homozygous F_2 families combined an earliness almost equal to Schroeder with a much greater boll size, which exceeded Schroeder by up to 2.2 g., producing a difference of up to 22 per cent. in yield. There seems to be no obstacle, therefore, to the production of early maturing cottons with higher yield.

In crosses between the local cottons (*Gossypium herbaceum*) the F_1 was generally intermediate in boll size, with occasional dominance of small boll in this case which was never observed in the American crosses. Similar polymeric segregation occurred in the F_2 , though again with a tendency towards the dominance of small bolls in certain combinations. Thus a cross was made between the smallest form obtainable, line 407 with a boll weight of 3.5 g., and an Afghan form with bolls of 5 g. The F_1 was intermediate and the F_2 , consisting of 194 plants, contained two groups, 102 plants all small like line 407, and 92 plants intermediate in boll size. No form with large bolls was obtained; certain other combinations, however, showed an increase in boll size both in the F_1 and F_2 , these being the cases when one parent contributed large numbers of locks per boll and the other parent large weight of seed per lock. Thus the cross between line 3280, with bolls of 4.1 g., and line 3155 of 5.49 g. gave an F_1 with bolls

of 5.8 g., whilst 3280, crossed by line 2519 (with bolls weighing 3.7 g.) gave an F_1 with bolls of 5.1 g.

Observations were made on the various factors making up ginning percentage, namely weight and number of fibres and weight of seed. Great variation was observed between different cottons; the number of fibres per seed calculated in seven varieties of American cotton, for instance, varied from 7.8 to 14.7 thousand, and in the two varieties of *G. herbaceum* from 3.6 to 9.2 thousand; the weight of a thousand fibres in American cottons varied from 4.4 mg. to 7.6 mg., and in *G. herbaceum* from 3.4 to 5.8 mg.; the seed weight varied from 97.0 to 167.2 mg. in American, and from 69.7 to 111.8 mg. in the local cottons. Variations were observed in the way in which the ginning percentage is made up, some varieties having a small number of fibres, but of a high individual fibre weight, others with a large number of light fibres. Crosses were made between these two types in the attempt to combine the characters fibre number and fibre weight. In the F_2 of such a cross between two *G. herbaceum* lines there appeared plants with a lower ginning percentage than the parents, and in others the ginning percentage was the same but differently constituted, whilst a third group constituted the desired combination of number and weight of fibres, and had a ginning percentage higher than the better parent by an amount varying from 7 to 13 per cent. Lines homozygous for this combination were obtained, an F_4 line constant for a ginning percentage of 8 per cent. more than the better parent being quoted. The same effect was observed in similar crosses of American cottons; a cross between Triumph, having a ginning percentage of 34.35 per cent., and a Transvaal cotton ginning 4.5 per cent. gave hybrids in the F_2 ginning 40, 41 and 42 per cent., and almost constant lines ginning 39.1 per cent. in F_4 , with every indication of giving constancy in the F_5 or F_6 .

A line of *G. hirsutum*, No. 253 with petal spots, was crossed with others without petal spot. The F_1 plants all had spots, but of less intense colour than the parent. The F_2 contained 585 plants with petal spot and 201 without, indicating a monohybrid inheritance for the presence of the spot, which was confirmed by back-crosses. Its intensity, however, showed a wide range of variation. The behaviour in the crosses with other spotless varieties was exactly similar, and in three crosses in *G. herbaceum* the same monohybrid ratios for petal spot were obtained.

Pollen colour was studied in crosses within *G. hirsutum*, and the yellow pollen colour of line 2107 proved dominant in crosses with four different varieties with white pollen, giving monohybrid ratios in the F_2 . In crosses between American cottons with yellow corolla and varieties with cream or white corolla, the yellow colour was dominant or partially dominant, with monohybrid segregation in the F_1 . The behaviour in crosses in *G. herbaceum* was exactly similar.

The boll type in *G. herbaceum* is much more variable than in the other species. The closed boll, a type desired for purposes of mechanical harvesting, proved to be a simple recessive to the open or semi-open type.

Anthocyanin pigmentation in the plant and sometimes the flowers gave simple 1 : 2 : 1 ratios in F_2 . Similar 1 : 2 : 1 ratios were obtained in crosses between forms with brown and white lint in American cottons. The intermediate forms appearing in the F_2 varied in shade, but all segregated in later generations and gave 1 : 1 ratios in back-crosses; the variations in shade are possibly due to modifying factors. Crosses in *G. herbaceum*, on the other hand, showed lint colour to be dependent on two or three factors. No homozygous lines of intermediate coloration were obtained in the F_3 of the dihybrid crosses, though this is probably due to the insufficiently large size of the populations studied.

323. SOME OBSERVATIONS ON THE INHERITANCE OF FORM AND SIZE IN ASIATIC COTTONS. By J. B. Hutchinson. (*Proc. 6th Int. Bot. Congr.*, Amsterdam, 1935,

2, p. 120. From *Pl. Bre. Absts.*, vi., 2, 1936, p. 177.) The genetic factors affecting leaf shape have little effect on leaf length, but mainly affect growth at right angles to the main leaf veins, the control being very local, possibly confined to the individual cell. Narrow and lacinated leaf are apparently recently acquired characters in cotton. *G. herbaceum* and *G. arboreum* are distinguished from one another by factors affecting shape of leaf lobes, small in individual effect, inherited quantitatively, and affecting all foliar organs. In general, leaf form depends on factors with a local effect as regards differences within species, and on factors with wide influence on the form of foliar organs as regards differences between species. Three main characters determine plant habit—viz., the node at which the first sympodial branch appears, the proportion of monopodial buds below that point which develop into branches, and the length of the monopodial branches. In any species there is a series of types differing in these characters, but with a balance between them, and this balance is maintained in crosses within a species, but not in crosses between species, in which case a complete range of all combinations of the three components appears in F_2 . Node number was found to be associated with three simple factors, but there are indications that many more factors are operating.

324. A NOTE ON THE INHERITANCE OF STRENGTH IN COTTON. By J. B. Hutchinson and P. D. Gadkari. (*Ind. J. Agr. Sci.*, v., 5, 1935, p. 619.) Two sterile rogues appeared in a pure culture of "Million Dollar" cotton grown in Trinidad, B.W.I. One of these sterile plants was distinguished from the rest of the population by its large flowers and complete sterility. The other could not be distinguished from the rest of the crop except by its almost complete sterility. A progeny of eleven plants was obtained from this plant. All were highly sterile, one was abnormal in appearance. Examination of pollen under the microscope showed that a very high proportion of grains was shrivelled and collapsed. A fertile F_1 was obtained by crossing with normal "Million Dollar." F_2 back-cross and F_2 data showed that sterility was inherited as a simple Mendelian recessive.

325. RESULTS OF COTTON VARIETY TESTS CONDUCTED IN THE COTTON REGIONS OF THE CENTRAL ASIA REPUBLICS IN 1932 AND 1933. By J. D. Nagibin. (*Bull. No. 1 (15) of the All Union Sci. Res. Cott. Inst., Sojuz NIHI*, Tashkent, 1935.) It is stated that the opinion of Zaitzev and others that it is impossible to grow Egyptian cotton in Central Asia is quite erroneous, and the Plant Breeding Stations have a wide range of the most valuable varieties. Successful work has also been done with breeding high yielding varieties of American cotton with good quality lint.

326. THE GROWING OF EGYPTIAN COTTONS IN TURKESTAN. By A. Emmanuilov. (*Bull. No. 2 of the Cent. Asia Sci. Res. Cott. Inst., Sredaz NIHI*, Tashkent, 1934.) (In Russian, with summary in English.) In selection work with Egyptian cottons, strain No. 1276 U., selected from Zagora, gave an increase of yield of 70 per cent., a length of lint of 42 per cent., and percentage of lint of 30-31 per cent. over Ashmuni. Strain No. 557, selected from Yuma cotton, was later maturing than Ashmuni, but gave a 99 per cent. increase in yield.

FIBRE, YARN, SPINNING, WEAVING, ETC.

327. COTTON FIBRE "CHARACTER." By C. L. Pattee. (*Text. Rec.*, liii., 634, 1936, p. 28.) The three factors, fineness, spirality, and maturity, describe the word "character," and these are briefly discussed.

328. COTTON BALE COVER FIBRES: EFFECTS IN SPINNING. By R. J. Cheatham and J. J. Brown. (*U.S. Dept. Agr. Preliminary Rpt.*, 1934, p. 30. From J.

Text. Inst., xxvi., 12, 1935, A613.) Commercial and laboratory spinning tests (waste, breaking load, end breakage, and uniformity of count) of cotton that had been covered with sisal, jute, or cotton bagging, and of cotton that was free from sisal or jute fibres, indicated no consistent differences that could be attributed to the presence of sisal or jute fibres.

329. VEGETABLE FIBRES: STRUCTURE. By R. Haller. (*Helv. Chim. Acta*, 18, 1935, p. 800. From *J. Text. Inst.*, xxvi., 11, 1935, A551.) Examination of cotton, hemp, and ramie fibres, treated with sulphuric acid, by means of iodine and safranin staining, affords no evidence for the existence of transverse elements in the fibres. The transverse structures, reported by other observers, using a similar technique, were probably portions of the cell membrane protected from the action of the sulphuric acid by the cuticle.

330. SOME COMPARATIVE TESTS ON VARIETIES OF COTTON: BRAZILIAN, ARGENTINE, AMERICAN. By C. Levi. (*Int. Cott. Bull.*, 49, 13, 1935, p. 706.) The results of a preliminary limited number of tests on three varieties of Brazilian, two of Argentine, and one of American cotton, are recorded, both numerically and graphically, for the following properties: chemical characteristics, staple length, convolutions, and tensile properties. The tests are being continued.

331. COTTON HAIRS: MATURITY DETERMINATION BY POLARIZED LIGHT. By E. R. Schwarz and G. H. Hotte. (*Text. World*, 85, 1935, p. 1477. From *J. Text. Inst.*, xxvi., 10, 1935, A523.) The authors reply to certain criticisms of the polarized light method of determining the maturity of cotton, and discuss the apparatus and technique.

[Cf. Abstrs. 309 and 642, Vol. XII., and 154, Vol. XIII. of this Review.]

332. MODIFIED O'NEILL COTTON HAIR STRENGTH TESTER. By N. Ahmad. (*Ind. Text. J.*, 45, 1935, p. 371. From *J. Text. Inst.*, xxvi., 12, 1935, A636.) Important features of this tester are the introduction of a U-shaped tube with floats for the liquid, of an electric contact device ensuring automatic needle stoppage when the hair breaks, and of a dial and needle to record the results.

333. COTTON: EFFECT OF STAPLE LENGTH ON SPINNING QUALITY. By C. D. Brandt. (*Text. World*, 85, 1935, p. 1833. From *J. Text. Inst.*, xxvi., 12, 1935, A613.) A curve is given showing the maximum spinning capacity of the various staples, and, for a given count, the staple required to spin a yarn of good running quality. Application of some general formulæ derived from this and similar curves to a 35's yarn shows good agreement between the graphical and mathematical solutions.

334. COTTON YARNS: MECHANICAL PROPERTIES. By H. F. Schiefer and D. H. Taft. (*J. Res. Nat. Bur. Standards*, 15, 1935, p. 237. From *J. Text. Inst.*, xxvi., 12, 1935, A637.) The results of tests on three sets (80's, 10's and 2/160's) of cotton yarns are discussed. The 80's yarn was spun from 1 $\frac{5}{16}$ in. staple Peeler cotton with twenty different twists, and the 10's from 1 in. staple Upland cotton with twelve different twists. Both yarns were spun with right-hand (Z), and with left-hand (S) twist. The 2/160's yarn was a mercerized yarn spun from 1 $\frac{3}{4}$ in. staple Sea Island cotton, and was considered to be of high commercial quality. The breaking load and extension were determined by single-strand, multiple-strand and skein tests. The variation in breaking load and extension, diameter, angle of twist, and irregularity of the 80's and 10's yarns with the amount of twist are shown. The average breaking load and extension per strand by the multiple-strand test are less than those by the single-strand test and greater than those by the skein test. The data are studied statistically, and an explanation is given of the differences obtained by the different test methods. Twelve

cones of the 2/160's yarn were tested for breaking load by the single-strand test. A statistical study of the data indicates significant differences in the average breaking loads between the different cones. Some of the factors that affect the strength of a cotton yarn are discussed.

335. COTTON YARN TESTING. By D. Atkinson. (*Text. Wkly.*, xvi., 402, 1935, p. 555.) Discusses the use of the lea, single thread and ballistic tests for determining the weaving qualities of cotton yarn.

336. AMERICAN MIDDLING COTTON: WASTE AND FOREIGN MATTER CONTENT. (*Cotton* [U.S.], 99, 7, 1935, p. 48. From *Summ. of Curr. Lit.*, xv., 18, 1935, p. 462.) Tests were made on sixteen bales of North Georgia $\frac{1}{8}$ in. cotton. This was passed through opening, cleaning and carding processes, and all waste was collected and weighed, and the laps and slivers were weighed. The total weight just before opening was 7,899 lb., and the actual weighed waste was 516 $\frac{1}{2}$ lb. The percentages were as follows: Bagging and ties, 4.44 per cent.; total waste from net cotton through scutcher room, 4.09 per cent.; from laps through the cards (based on net cotton fed), 5.17 per cent.; from net cotton fed through the cards, 9.26 per cent. The total invisible waste was 2.41 per cent. When the waste was analyzed by passing through a willowing machine and wire screen, it was found to contain 88 lb. of sand and leaf, and 16 lb. of broken seed and bulky waste which could be classed as foreign matter.

337. MIXING PRACTICES IN JAPAN. (*Int. Cott. Bull.*, 49, 13, 1935, p. 675.) In Japan the mixing of two growths having staple lengths differing more than $\frac{1}{8}$ in. is reported to be not uncommon. Some of the extremes in mixing of various yarn counts are tabulated. Each mill has its own method of blending. The blending of many kinds of cotton enables the Japanese spinners to take advantage of changes in the relative prices of important growths much more readily than if less flexible mixing practices were followed.

338. NOTES FOR THE ECONOMIC LIFE OF TEXTILE MACHINES. (*Text. Exporter*, xv., 120, 1935, p. 17. From *J. Text. Inst.*, xxvi., 12, 1935, A654.) The article refers to the question of efficiency in the textile industry, and how production costs can be reduced appreciably by a fuller use of modern machinery and appliances.

339. SPINNING MILL: PRODUCTION CONTROL. (*Spinn. u. Web.*, 33, 38, 1935, p. 1. From *J. Text. Inst.*, xxvi., 11, 1935, A557.) The distribution of work and control of production in a spinning mill are discussed, and a brief account is given of a recording system whereby it is possible to follow the progress of an order, and to determine the raw material requirements and the efficiencies of the different machines and operatives.

340. SPINNING PROCESSES: DISCUSSION. Southern Textile Association. (*Cotton* [U.S.], 99, 7, 1935, p. 52. From *J. Text. Inst.*, xxvi., 10, 1935, A492.) The following are discussed: (a) *Fly in high draft spinning.* More fly is observed in the spinning room when high draft spinning is used. Oiling the cotton is recommended for keeping down the fly. (b) *Cork roller coverings.* In one case it is reported that cork roller coverings do not give good results in spinning 40's and 36's. In another case good results with 14 $\frac{1}{2}$'s and 15's are reported.

341. THE USES OF COTTON FOR ROADWAYS. (*Text. Rec.*, liii., 632, 1935, p. 11.) Many of the cotton states, including Texas, Georgia, South Carolina, and New Jersey, are using cotton fabric in road construction. A pamphlet issued by the U.S. Cotton Textile Institute, New Uses Section, reviews the development of cotton roads, and describes construction technique, which is illustrated by photographs of actual building operations, and quotes official reports of State super-

visors who have observed the performance of cotton roads in service. The cotton fabric is used as a reinforcing membrane between the road base and the bituminous top surface, and the advantages claimed for such a membrane are that it prevents premature ravelling, erosion, cracks and other failures of the top surface, and prevents the road-base substance from forcing its way through the bituminous surface. It is also claimed that it ensures greater travelling comfort, and that the initial cost of the fabric is more than offset by the economies in maintenance charges. The cotton fabric used is not a patented article, and can be produced by any cotton mill regularly producing coarse cotton goods. What has been done in this connection in this country?

342. COTTON ROAD FABRIC: APPLICATION. (*Text. World*, 85, 1935, p. 2031. From *Summ. of Curr. Lit.*, xv., 23, 1935, p. 614.) "Cotton roads" have been laid in five States in America. The surface of the road is treated with tar-oil, the cotton fabric (75-90 inch osnaburg with 16-20 picks per inch) is placed directly on this, covered with asphalt, and surfaced with gravel. The estimated cost per mile for an 18-foot road is about \$600.

343. NITROGENOUS COTTON CONSTITUENTS: IDENTIFICATION. By M. M. Tschilikin. (*Sa Rekonstr. tekstilnoi Prom.*, 12, 6, 1933. From *J. Text. Inst.*, xxvi., 12, 1935, A636.) The author has isolated dimethoxyphenyl- α -aminopropionic acid from raw cotton.

LEGISLATION.

344. CEYLON: *Summary of legislation affecting the import of plants into the country in force on December 31, 1934.* (Dept. of Agr., Ceylon.) States the conditions governing the importation of cotton seed, unginned cotton or lint of any species of *Gossypium*.

345. TANGANYIKA TERRITORY: Cotton (Fees) Rules, 1935. *Government Notice* No. 85 (June 6, 1935) states the fees payable for the year ending March 31, 1936.

346. Cotton (Restriction on Removal) Rules, 1935. *Government Notice* No. 84 (June 6, 1936), prohibits the removal of unginned cotton from certain areas without a written permit from the Director of Agriculture.

347. UGANDA: Ordinances No. 1 of 1934 (dated January 27, 1934), *No. 18 of 1934* (October 24), and *No. 26 of 1934* (November 30) amend certain sections of the Cotton Ordinance, 1926.

348. AUSTRALIA: Raw Cotton Bounty Act, 1934. *Statutory Rules, 1935, No. 31*, dated March 28, 1935, amend Regulation 3 of the Raw Cotton Bounty Regulations, the word "one-quarter" being inserted in place of the word "one-half."

Raw Cotton Bounty Act, No. 6 of 1935 (assented to April 5, 1935), amends Section 9 of the Raw Cotton Bounty Act, 1934.

349. QUEENSLAND COTTON BOARD (*Queens. Agr. J.*, xlv., 4, October, 1935, p. 534.) An Order in Council, issued under the Primary Producers' Organization and Marketing Acts, amends the constitution of the Cotton Board by providing for certain alterations in the boundaries of the cotton districts.

The definition of a grower has been amended 'to provide that the class of persons who shall be eligible to vote on any referendum or election shall be persons who have, during the twelve months preceding the referendum or election, delivered to the ginneries seed cotton which was grown by them on land of which they were owners or tenants, or who, during such preceding twelve months, have furnished a cotton return to the Board showing such owner or tenant to be a bona fide cotton grower.

350. WEST INDIES. ST. VINCENT: *Plant Protection Ordinance, 1935.* (*Govt. Gaz. St. Vincent, August 2, 1935.*) Regulates or prohibits the importation of any plants which may be a means of introducing pests or disease into the Colony.

TRADE, CO-OPERATION, ETC.

351. THE WORLD COTTON POSITION. (*Text. Wkly., xvi., 403, 1935, p. 583.*) Gives statistics of cotton production in all countries from 1926-27 to 1934-35; mill consumption of American cotton, by countries, 1926-27 to 1934-35; mill consumption of all growths of cotton in all countries, 1923-24 to 1934-35.

352. FORECASTING COTTON PRICES. By W. H. Slater. (*Text. Wkly., xvi., 407, 1935, p. 707.*) A report of a lecture given by the author in which his method of forecasting cotton prices is discussed.

353. SILVER IN RELATION TO MONETARY POLICY AND THE COTTON TRADE OF THE WORLD. Federn. of Master Cotton Spinners' Assens., Ltd. (*Int. Cott. Bull., xiii., 25, 1935, p. 488.*) Lack of confidence in silver as a store of value has caused a flight from silver-hoarding to gold-hoarding, and has also caused Governments to sell silver for gold in building up currency reserves. Depreciated silver has, in this way, been a contributory cause in forcing down the value of commodities in gold and in currencies rigidly or loosely attached to gold, and has thus helped to depress the price level of wholesale commodities and to reduce the earnings and purchasing power of producers in most parts of the world. The decline in the wholesale price level of primary commodities has inflicted particularly great hardships upon the farming communities of the world, who are the principal consumers of cotton goods; and not until their lost purchasing power is restored will the problems of the world's cotton industry be solved.

The remedial policy required to restore world purchasing power and to put the cotton trade upon a prosperous footing is conveniently summed up in the demand for the reversal of all post-war deflationary measures. All other aims in monetary policy should be subservient to the urgency of the need for a universal restoration of wholesale commodity prices to a prosperity level. As one of the essential means to this end, silver should be restored wherever possible to the place it held in the monetary systems prior to 1920 and during the war. The particular regions concerned include India, Asia in general, Africa, and Central and South America; and the more advanced countries should assist them in rehabilitating silver.

ADDENDA.

354. VERNALIZATION AND PHASIC DEVELOPMENT OF PLANTS. (*Bulletin No. 17. Publ. by the Imperial Bureau of Plant Genetics, Aberystwyth and Cambridge, 1935. Price 10s.*) In a foreword contributed by Sir David Chadwick to this most informative publication, it is stated that in March, 1933, the Imperial Bureau of Plant Genetics at Aberystwyth and Cambridge published a bulletin on "Vernalization or Lysenko's Method for the Pre-Treatment of Seed." Till then little was known of this method or theory. The original papers were only available in Russian, and the very few references in papers in other languages had been extremely brief. The issue was soon sold out. Research workers in practically every European country, and also in countries as far apart as Canada, Australia, Ceylon, Brazil, and China, examined the process and confirmed or challenged the results or theory. Many communicated their observations to the bureaux. Meanwhile, close touch was maintained with the Russian research workers.

Owing to the interest aroused, and to the developments taking place, the present publication has been prepared. It sets out the theories of Lysenko and of other schools of thought, and summarizes the results obtained in Russia and elsewhere as well as the practical application of vernalization so far as that has been tried. It brings all that information as near as possible up to date.

The first section deals with Research in the Soviet Union, and discusses the following: theories; experiments on the effect of temperature, light, and other factors on development; biological processes associated with plant development; vernalization of various agricultural plants; application of the theory of phasic development.

The second section is concerned with vernalization in countries other than the Soviet Union; these include England, Irish Free State, France, Germany, Italy, Sweden, Holland, India, China, Burma, South Africa, Kenya, Canada, United States, Brazil, and Australia. Lists of over 100 references to the literature on the subject are included, together with an index of crops and an index of Russian journals with their translated titles. [*Cf. Abs. 631, Vol. X. of this Review.*]

355. TROPICAL PLANTING AND GARDENING. By H. F. Macmillan. (Pubd. by Macmillan & Co., Ltd., London, 1936. Price 25s. net.) The fourth edition of this useful work has just been issued. The book has special reference to Ceylon, but will be appreciated by all interested in or connected with agricultural or horticultural undertakings in the tropics, and especially by residents desirous of establishing or improving their gardens. A foreword is contributed by Mr. F. A. Stockdale, Agricultural Adviser to the Secretary of State for the Colonies. All sections of the work have been revised and some completely re-written, and an extra chapter has been included devoted to arid or sub-arid regions, where the need for introducing suitable species or varieties, and for the study of special methods of cultivation is keenly felt. Everything appears to have been dealt with in the book—climate, soils, manures, implements, fruit cultivation, vegetables, spices, ornamental plants and trees, all kinds of plants and economic products, and insect pests and diseases. Numerous illustrations are included of trees, plants, flowers, etc., and there is also a good index. To those proceeding to the tropics for the first time the book should prove invaluable.

356. RÉPERTOIRE INTERNATIONAL DES CENTRES DE DOCUMENTATION CHIMIQUE. (Pubd. by the Office International de Chimie, 28, rue Saint-Dominique, Paris, VII^e. 1935.) A useful publication giving names, addresses, availability of documents, resources, publications, etc., of associations, societies, etc., concerned with chemical matters, including soils. It is hoped that the publication of the Repertory will serve to direct an enquirer to the nearest institution in a position to supply him promptly with the documentation of which he stands in need. All the information is given in French, English, and German.

PERSONAL NOTES

We offer our sincere congratulations to Sir Norman Seddon Brown on the honour of Knighthood conferred on him, announced in the New Year's Honours List. Sir Norman Seddon Brown has been a representative of the Federation of Master Cotton Spinners' and Doublers' Associations on the Administrative Council of the Corporation, and also on the Executive Committee, since 1923.

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are on the Fourth Floor of King's Buildings, Dean Stanley Street, Millbank, S.W. 1.

At the time of writing, the following officers are on leave, or will shortly be arriving in England from cotton-growing countries:

Ceylon	...	...	...	...	...	Mr. M. Park.
"	...	...	...	...	...	Mr. R. E. Ponniah.
Fiji	...	...	...	...	...	Mr. W. L. Parham.
Kenya Colony	...	...	...	...	...	Mr. W. L. Watt.
"	"	...	...	...	...	Mr. H. Wilkinson.
Nigeria	...	...	...	...	...	Mr. G. W. G. Briggs.
"	...	...	...	...	...	Mr. K. T. Hartley.
"	...	...	...	...	...	Mr. B. G. Owen.
"	...	...	...	...	...	Captain H. G. Poynter.
"	...	...	...	...	...	Mr. O. S. Swainson.
"	...	...	...	...	...	Mr. C. B. Taylor.
"	...	...	...	...	...	Mr. O. J. Voelcker.
Sierra Leone	...	...	...	...	...	Mr. E. I. Nisbett.
Sudan	...	...	...	...	...	Mr. M. A. Bailey.
Tanganyika Territory	...	...	...	...	...	Mr. E. Harrison.
"	"	...	...	...	...	Mr. A. S. Richardson.
"	"	...	...	...	...	Mr. D. Sturdy.
Uganda	...	...	...	...	...	Mr. R. P. Davidson.
"	...	...	...	...	...	Mr. N. S. Haig.
"	...	...	...	...	...	Mr. A. B. Killick.
West Indies : <i>Barbados</i>	...	...	...	...	...	Mr. G. C. Stevenson.

The following officers of the Corporation's staff abroad will shortly be arriving in this country on leave:

Nyasaland	...	...	...	...	...	Mr. S. T. Hoyle.
South Africa	...	...	...	...	...	Mr. O. V. S. Heath.
"	...	...	...	...	...	Mr. F. R. Parnell.
Swaziland	...	...	...	...	...	Mr. J. V. Lochrie.

THE EMPIRE COTTON GROWING REVIEW

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No. 3

EMPIRE COTTON PRODUCTION: A REVIEW OF PROGRESS

BY

SIR JAMES CURRIE

At a recent meeting of the Executive Committee of the Corporation, it was suggested that I should compile a survey of cotton production in the Empire during the last five or six years, showing the progress made as expressed in actual bales.

The following are the figures for the crops from countries other than India for the seasons 1920-21, the year the Corporation came into being, and 1934-35, and I do not think there is much cause for dissatisfaction with them, considering the general world conditions during the last six years.

1920-21	...	...	...	166,154 bales of 400 lb.
1934-35	...	...	...	727,989 „ „

Details for the seasons between 1925 and 1935 are given in the table on page 215.

The British Cotton Growing Association had been doing yeoman pioneer work for nearly twenty years before the Corporation received their Charter, and in 1902, the year in which the Association was founded, African production (excluding Egypt) was only 325 bales. Since 1921 we have been working hand in hand, and I cannot let this opportunity pass without expressing my thanks for all the help we have received, personally from Sir William Himbury, and from the Association as a whole, ever since the day we started work. We cannot, of course, claim that the Association and the Corporation are directly responsible for the whole of the increase in the Empire crop since we each commenced work, but I make bold to say that the two bodies have exercised a very considerable influence.

At this point it is perhaps necessary to explain why Indian production is not included in these figures, nor is further reference

made to it in this article. The reason is that the Corporation's activities do not extend to India, where cotton development is in the hands of the Indian Central Cotton Committee; with this body the Corporation maintain close touch, and they are also directly represented on it. The work of the Lancashire Indian Cotton Committee under the Chairmanship of Sir Richard Jackson, who is also Chairman of the Executive Committee of the Corporation, has already led to a notable increase in the consumption of Indian cotton in this country, and the production of medium and long stapled cotton in India has increased appreciably in recent years.

In my view, one of the chief factors that has contributed to progress in the production of Empire cotton in recent years has been the revolution in the quality of agricultural officers available for work in the tropics. This has been directly brought about by the work of the Imperial College of Tropical Agriculture and the post-graduate scholarship scheme of the Corporation, on which that of the Colonial Office was admittedly modelled. The Corporation's scheme enabled us not only to provide ourselves with a highly efficient staff, but also to supply to the Colonial Service or to the Sudan no fewer than thirty-nine officers who received their final training at the expense of the Corporation.

As regards the College, apart from considerable financial aid, the Corporation were able to furnish them with a member of their staff in the shape of Sir Geoffrey Evans as Principal, whose administrative work, in spite of being hampered by lack of funds, has been beyond all praise. A further great step in advance consisted in the appointment of a distinguished agriculturist as Adviser to the Colonial Office.

To turn now to the various cotton-producing countries—the Sudan and Uganda come first. Three times during the last five seasons the Uganda crop has been the largest, while the Sudan took first place in 1931-32 and in 1934-35.

The Uganda crop in 1930-31 amounted to just under 200,000 bales, was a little over that figure in the next year, rose to just under 300,000 bales in 1932-33, and dropped back a little to 286,000 and 253,000 in 1933-34 and 1934-35. The estimate for 1935-36, however, is a record—namely, 305,000 bales, an increase actually of 114,000 bales in six years, or over 50 per cent. Compared with 1920-21 the increase has exceeded 274 per cent. In Uganda, perhaps more than in any of the other Crown Colonies, the Corporation's Studentship scheme has borne fruit. One-third of their senior agricultural staff were holders of our studentships, from the Deputy Director

downwards. The Corporation are now assisting in the establishment of a seed farm for Buganda, which is to be linked up with the development of mixed farming. If soil exhaustion is to be avoided, this is most essential work.

In the Sudan, the Corporation have been responsible for the cotton-breeding work since 1925. The whole of their agricultural research work was reorganised a few years ago and placed under the direction of Mr. Bailey, then our plant breeder. This followed on a Report made by Sir John Farmer after a visit carried out at the invitation of the Government. The results of the reorganization and the work of the plant breeders appear to me to have saved the Gezira and averted disaster to the Government.

In addition, Mr. Bailey and Mr. Trought, whom the Corporation appointed to succeed him as Chief Plant Breeder, have been working for some years on strains suitable for the conditions in the South. The Government propose to have an ecological survey made, and to push forward with development there. The Corporation have provided them with Mr. Anson, a plant breeder of considerable experience, for work in the Nuba Mountains.

The problem in the rainfall areas is very largely one of transport. The work carried out by the Oversea Mechanical Transport Committee, to whom the Corporation extended the hospitality of their offices for six and a half years, is of great importance in this connection. I have every hope that the motor vehicles evolved by the Committee may yet assist considerably in further Sudan development.

The crops for the last five seasons have been as follows: 120,000, 235,000, 137,000, 157,000, and 296,000 bales. It is to the work of their Agricultural Research Service that they are looking with justifiable confidence to flatten out these serious fluctuations in yield, and at the same time to raise the average.

In Tanganyika progress during the last five years has been astonishing. From the 11,000 bale crop in 1930-31, which was about half what they had averaged for the previous seven years or so, they had jumped to 39,000 bales by 1933-34, and increased this to nearly 58,000 bales in 1934-35. The Corporation have given considerable financial assistance in extending the four main cotton experiment stations, at two of which the work is being combined with large-scale schemes of native holdings involving the economic use of cattle and proper rotations.

Next comes Nigeria. Of all the colonies with which we deal, this is the most susceptible to fluctuations in price. In seasons of high prices, a large percentage of the cotton crop is exported. In

seasons of low prices, however, an abnormal proportion is absorbed by the local spinning and weaving industry, and probably a restricted acreage is planted in the following season. When this question was being discussed with the Corporation in 1932, the Director of Agriculture said that it is extremely difficult to estimate the amount normally used for the manufacture of native cloth. He put it then at not less than 20,000 bales, possibly even 30,000 bales. The result has been that although exports in 1929-30 amounted to 44,000 bales, the total in 1930-31 dropped to 18,850 bales, and fell as low as 6,268 bales in 1931-32. There was a recovery to 24,000 and 28,000 bales in the next two years, and in 1934-35 a new record for exports was established of practically 59,000 bales. The estimate for 1935-36 is still higher, namely 70,000 bales. In an address to the Administrative Council of the Corporation last October, Mr. Browne, who is in charge of the Corporation's Seed Farm in Northern Nigeria, described the prospects there; all the evidence goes to show that the introduction of mixed farming into Nigeria should do more for the increase of cotton production in the North than any step that the Agricultural Department have so far taken. The Corporation are assisting in this scheme, and I hope that gradually a large community of contented native cultivators, ploughing their land with oxen instead of laboriously hoeing it by hand, and making use of a proper rotation system and of farmyard manure, will be established on land which we have cleared and brought under cultivation at Daudawa.

Nyasaland shows signs of really going ahead at last. The Corporation are now concentrating their attention on an area a good deal to the north of that in which they first began work. It is to be hoped that our efforts may be successful, as the country has burdened itself with an extension to the railway, and our Experiment Station is situated about seventeen miles from railhead. Mr. Parnell, the officer in charge of the Corporation's Station in South Africa, visited the Station recently, and was somewhat apprehensive of the damage that might be caused by stainers. Mr. Ducker, the Corporation's senior officer in Nyasaland, however, is optimistic, and in any case I trust that the concentrated work on insect problems which is now being carried out at Barberton and the Stations closely linked with it will enable us to mitigate the damage at present so widely caused by these pests. Our staff in Nyasaland are participating in this work.

In 1930-31 the crop amounted to 4,000 bales, and in the next two seasons was increased by approximately 1,000 bales each year. It then rose to 10,700 bales in 1933-34, and to 21,000 bales in 1934-35.

In Kenya cotton is beginning to assume increased importance, and the crop has expanded rapidly in the last few years, reaching nearly 9,000 bales in 1984-85. At the request of the Governor, the Corporation was able to send Mr. Milligan, who had just resigned from the position of their senior officer in Africa, to visit the Colony last year, and it is hoped that his recommendations will enable the industry to be placed on sure foundations.

The West Indies show no striking increase; in fact, the level of the crop is nowadays lower than it used to be, because by collective action of the growers the area is restricted voluntarily. We are doing all we can to help here, and the Head of the Genetics Department of our Research Station, Trinidad, is Cotton Adviser to the Commissioner for Agriculture. We have also an Experiment Station in St. Vincent, which has done excellent work in preserving the purity of the St. Vincent strain of Sea Island cotton, and is assisting in other directions also.

In Trinidad we have, of course, our central Research Station. The work consists primarily of long-range investigation, and so far, although results have been obtained and technique evolved which are of considerable importance in botanical and plant-breeding circles, improvements in large-scale production of cotton due to such work can only be looked for when its results have been assimilated and applied. However, the Corporation long ago decided—and it was a vital decision—that we could not afford to let slip the chances that long-range research might give us, in the belief that, in addition to the knowledge which the staff at the Research Station would, we knew, add to the general stock of information regarding the growing plant and the inheritance of characters, some fact as regards its evolution or growth might at any moment come to light that would ultimately have far-reaching results in the way of increased yields or improved quality.

Southern Africa has proved disappointing as a producer of actual bales, but the Corporation's staff at Barberton have produced types of cotton which are now not only in use all over East and South Africa up to the Nuba Mountains, but have in some areas entirely replaced the less satisfactory types formerly grown. In addition, the entomological work originating there, and most vigorously pursued in Swaziland and both the Rhodesias, if it succeeds in tackling bollworms and stainers, which so far have been a definite bar to progress, will open up a vast area ranging from Swaziland to the Congo border. They have already defeated the jassid by the production of U.4 cotton.

There remain Queensland, Cyprus, Southern and Northern Rhodesia, the Gold Coast, Ceylon, Fiji and Malta. With the exception of Queensland, with a crop of 18,000 bales in 1934-35, present production in these countries does not amount to very much. The Corporation helped Queensland in their early days by sending them two experts, including an entomologist; later they were able to stand on their own feet as regards staff.

It is still hoped that the Rhodesias may in time produce fair-sized crops, but they will, I think, be grown almost entirely by natives and not by European settlers. Insects are the chief bar to expansion at the moment, and this side of the work is, as I have already mentioned, linked up in those countries with the investigations being carried on at Barberton. Cotton development in Southern Rhodesia is to be placed in the hands of a Board of Trustees appointed by the Government, and the Corporation's senior representative in that country, Major Cameron, is to be Chairman of the Board, and will also represent the British Cotton Growing Association.

Until last year we were helping the Government of Fiji in an attempt to produce a type of cotton suited to their local conditions that would have a wider market than the small amount of Sea Island cotton they had been producing. Mr. Anson did valuable work there, and has left strains which the local Department of Agriculture should be able to multiply. As already mentioned, he was transferred last year for work in the Sudan.

Considering the backwardness of Africa and the world commodity slump, the increase in the Empire cotton crops by over 300 per cent. in the last fifteen years must be regarded as satisfactory and encouraging, and I feel pretty certain that expansion will continue, especially if unremitting attention is paid to the development of mixed farming. The work has been definitely retarded by the great commodity slump of 1929, and the consequential economies. Some of these were inevitable; others naturally have caused differences of opinion. To give concrete examples, I regret the maiming of the ecological survey in Northern Rhodesia, caused by the abolition of the soil chemist, especially as, from one source or another, the money for his retention could have been made available. Again, the failure of the Sudan Government to provide itself with a trained agricultural staff, coupled with their expression of opinion when formally approached by a deputation, which included well-nigh all qualified to advise, that the trained Trinidad product would be of no value to them, also marked a deplorable lapse. This, however, has subsequently been rectified.

Taken all in all, I would say that the effect of the slump has been less serious than might have been expected, and that, given improved world conditions, progress in the near future ought to be marked. But I am well aware that these are precarious times in which to prophesy.

THE WEST INDIAN SEA ISLAND COTTON ASSOCIATION

ITS FORMATION AND WORK

BY

C. C. SKEETE, B.A.,

Assistant Commissioner of Agriculture, Honorary Secretary.

I. AN HISTORICAL SKETCH OF THE FORMATION OF THE WEST INDIAN SEA ISLAND COTTON ASSOCIATION.

THE British West Indian Sea Island cotton industry was one of the first among agricultural industries to be seriously affected by the world-wide economic depression. By the end of 1930 there was a very marked shrinkage in demand for Sea Island cotton lint, and stocks were rapidly accumulating in the Liverpool markets. Furthermore, the areas planted under Sea Island in 1930 were considerably greater than in the two or three preceding years. It became obvious, therefore, that the accumulation of stocks would soon be excessive, while the chances of disposing of these stocks continued to diminish week by week, and a sense of uneasiness and uncertainty, amounting almost to despair in the future of the industry, became widespread amongst cotton growers in the Islands. It was then that certain far-seeing representatives of the industry—and particularly among these mention must be made of Mr. T. A. Twyman, of the Montserrat Company—urged that the time had come for growers to organize themselves for action to endeavour to save their industry. Representations were also made to the Secretary of State for the Colonies from various sources emphasizing the plight of the industry and seeking advice and assistance.

The outcome of preliminary enquiry and investigation was that a meeting of cotton interests was convened by the Empire Marketing Board and held in London in July, 1931. The meeting was conducted under the Chairmanship of Sir Edward Davson, and attended by representatives of the Empire Marketing Board, the Empire Cotton Growing Corporation, the West India Committee, the Imperial College of Tropical Agriculture, Messrs. Gillespie Bros. and Co., and of the cotton growers in the islands of Antigua, Montserrat and St. Kitts. At that meeting the over-production as well as the under-

consumption of cotton was emphasized, and the meeting came to the conclusion that an organization should be formed to investigate the marketing conditions of Sea Island cotton, and to endeavour to stimulate its consumption by finding new uses and new markets for it. Professor H. A. Ballou, then Commissioner of Agriculture, was requested to make known to the cotton growers in the West Indies the decision of this meeting and to place the facts of the situation of the industry before them.

On the invitation of the Government of Barbados a conference of cotton growers in the British West Indies was arranged and held in Barbados in April, 1932. The conference endorsed the decision of the meeting held in London during the previous year, in that some form of organization of British West Indian Sea Island cotton growers was desirable, and agreed upon a provisional scheme for the formation of a Cotton Growers' Association, based on the main points of a scheme submitted by Mr. T. A. Twyman. The scheme involved the early formation of local cotton growers' associations in the islands concerned and called for the imposition by Governments of an export tax on cotton, to raise the necessary funds to inaugurate the inter-Island Association. In due course the local associations were formed and the necessary funds raised.

In the meanwhile the preliminary work in connexion with the formation of the West Indian Association was undertaken by Professor Ballou and his staff in the Agricultural Advisory Department of the Imperial College of Tropical Agriculture, and in November, 1933, a second cotton conference was held at the Imperial College in Trinidad, when the West Indian Sea Island Cotton Association was formally brought into existence. The conference defined the constitution of the Association, its objects and rules, and considered how it might be financed.

The Commissioner of Agriculture is the President of the Association, and its members are representatives from the island associations. The funds are derived from an export tax on cotton lint, imposed, collected and handed over to the Association by the Governments of those islands in which the local associations are members of the West Indian Association. The secretarial and clerical services are provided by the Agricultural Advisory Department of the Imperial College of Tropical Agriculture, in whose offices the headquarters of the Association are established.

One of the important recommendations of both conferences, in Barbados, 1932, and Trinidad, 1933, was that an Advisory Committee in England should be appointed in order to superintend and assist

the work of the Association in the United Kingdom. In consequence the wish was expressed by the newly formed Association that the Colonial Office should undertake the formation of this Advisory Committee, and that representatives of the cotton industry in the various islands and representatives of certain organizations in the United Kingdom should be invited to serve on it.

In March, 1934, the Secretary of State for the Colonies convened the first meeting of the Advisory Committee in England, constituted as follows:

Mr. F. A. Stockdale, C.M.G., C.B.E. (representing the Colonial Office and the Colonial Advisory Council of Agriculture and Animal Health).

Representatives of the British Cotton Growing Association, the Empire Cotton Growing Corporation, the West India Committee, the cotton-producing islands in the British West Indies.

Later in the year arrangements were made with the Leicester and Nottingham Chambers of Commerce for representation on the Committee on special occasions.

During the first two years of the life of the Committee, the British Cotton Growing Association loaned the services of Mr. T. B. Hoe to perform the duties of Secretary and Treasurer. Arrangements are now being made for carrying on these services.

II. THE WORK OF THE ASSOCIATION.

The work of the Association may be conveniently considered under two separate heads—namely, that accomplished in the United Kingdom by the Advisory Committee in England, and that accomplished by the Executive Committee of the Association in the West Indies. The fact remains, however, that in many instances the work of these two bodies is closely linked together, and cannot be accounted for entirely under the one or the other head.

(i.) THE WORK OF THE ADVISORY COMMITTEE IN ENGLAND.

The Committee has held twenty meetings since its inception in March, 1934. Its work may for convenience of description be divided into three main categories:

- (a) Protection—to safeguard the use of the description "Sea Island" cotton.
- (b) Research—to find new uses for Sea Island cotton.
- (c) Increase in consumption—to advertise or give publicity to Sea Island cotton and the materials manufactured therefrom.

(a) *Protection*.—The first important task the Advisory Committee undertook was that of the registration of a trade or certification mark for goods made from one hundred per cent. Sea Island cotton. The necessity for such a mark was felt from an early date, but as time went on many complaints were received concerning cases where goods alleged to be wrongly described as “Sea Island” were being offered to the public, consequently the necessity for the registration of such a mark became urgent. In its endeavours to secure this mark the Committee met with several obstacles, and the requirements to be fulfilled before a trade-mark of the character suitable for the purposes of the Association could be granted were irritatingly numerous. A particular requirement was the necessity to constitute the Association or the Advisory Committee as a corporate body, with legal powers of action. It was not considered desirable to incorporate the Advisory Committee, and it was found that such incorporation of the Association could not be effected in a short time. The Board of Trade, however, agreed to issue the trade-mark provided a power of attorney was granted to the Advisory Committee by the Association so that the Committee would be in a position to take legal proceedings, if necessary, in the event of opposition to and infringements of the mark. A general power of attorney was in due course furnished to the Committee.

Much time and effort were spent in preparing rules and regulations for governing the use of the mark. In this connexion it may be of interest to readers to know that the following definition of Sea Island cotton was acceptable to the Patent Office—“Sea Island cotton means the fine long staple variety of cotton well known in the market under that name.” The Retail Trading Standard Association defines Sea Island cotton as “a fine, strong, lustrous cotton of long fibre grown usually in the West Indian Islands.”

In June, 1934, the firm of Messrs. Reginald W. Barker and Co. received their authority to proceed with the registration of the name “Sea Island,” but it was not until July, 1935, that the certificates of registration were finally granted. Not only was there much work involved before the trade-mark was granted, but the registration of the mark was immediately followed by the task of issuing, controlling and superintending its use, a task not without its problems and necessitating the establishment of personal contacts and the securing of the goodwill of users. The Committee were fortunate in that Mr. T. A. Twyman undertook this important administration work during the first year of the existence of the mark. In addition to personal interviews with many users, it was necessary to advertise

the trade-mark in trade journals, and for this purpose alone the Association expended the sum of £250.

Rules and regulations were drawn up concerning the administration and control of the use of the mark. One of the functions of the Committee in this respect is to satisfy itself that the cotton content of goods described as "Sea Island" goods is, in fact, "Sea Island," and to this end an arrangement has been made with the Shirley Institute for testing articles to determine the proportion of Sea Island cotton contained therein. Further, it has been arranged that the President of the Manchester Chamber of Commerce should act as Appeal Authority in the event of disputes arising concerning a person's right to make use of the trade-mark. By the end of January, 1936, forty-seven agreements had been signed on behalf of the Association, and certificates granted to applicants for the use of the trade-mark.

(b) *Research*.—One of the most important lines of research work so far undertaken aims at the preparation of a material consisting of a wool-cotton mixture. This work has been undertaken at the laboratories of the Wool Industries Research Association, at Torridon, Headingley, Leeds, under the direction of Dr. S. G. Barker, and is being financed by the West Indian Sea Island Cotton Association. The objects of the work undertaken were to discover in what ways the special characteristics of Sea Island cotton could be utilized in conjunction with wool, when processed on ordinary wool textile machinery. It was thought that a valuable extension of the field of employment of Sea Island cotton would result if it could be shown that its special fineness and staple length rendered possible the methods of manufacture and effects not practicable with other fibres.

A number of attempts were made to blend the wool and cotton, and eventually a technique has been successfully developed for preparing mixed rovings of Sea Island cotton and wool. This process involves the use of English worsted machinery, but some improvements are still considered to be possible by adaptation on the lines of French drawing machinery.

The following is quoted from a preliminary report on this work issued by the Wool Industries Research Association: "Many attempts have been made to manufacture yarns from mixtures of Sea Island cotton and wool from which garments could be manufactured possessing the desirable warmth, the absorbent qualities of wool, and the 'lightness' and smooth handle of Sea Island cotton fabrics. The obstacle that has hitherto prevented the realization of this ideal

is that ordinary wool imparts to the mixture fabric two of its most undesirable qualities—namely, liability to shrink on laundering and its prickly feel. The development by the Wool Industries Research Association of a process for rendering wool resistant to shrinkage *before* conversion into yarn has made a modified wool available for blending with Sea Island cotton to produce a mixture that can be converted into a homogeneous cotton-wool yarn. This modified wool not only does not shrink, but has lost its ‘woolly’ feel without losing either its warm handle or capacity to absorb moisture and perspiration.” Further, it is claimed that new yarns obtained from blends of Sea Island cotton and wool, subjected to special treatment by the Wool Industries Research Association, will also be found valuable for the manufacture of light-weight dress materials and other fabrics for purposes where the warmth of wool but the lightness of cotton and its resistance to felting during washings are required.

Other investigations have been conducted, involving much enquiry and experiment, in order to find other possible new uses for Sea Island cotton. A material containing Sea Island cotton was tried for use in airplane wings, but was eventually found unsuitable. Experiments, however, are being continued to find out whether it can be used in the materials from which parachutes are made. The possibility of using Sea Island cotton in the manufacture of sailcloth has also been carefully investigated. In general, the Advisory Committee has established close contact with firms who have shown interest and initiative in the manufacture and marketing of fabrics made from Sea Island Cotton.

(c) *Increase in Consumption of Sea Island Cotton.*—The Advisory Committee have lost no opportunity for giving publicity to Sea Island cotton and the goods manufactured therefrom. As the result of discussion and co-operation with the publicity agent of Messrs. Austin Reed, Ltd., an extensive advertising programme was arranged and carried through. Messrs. Austin Reed, Ltd., staged window displays of Sea Island cotton goods in their Regent Street shop, and have from time to time advertised extensively in the leading illustrated papers. Further, by arrangement, the Secretary of State for the Colonies visited and inspected the display of Sea Island cotton goods at Messrs. Austin Reed’s Regent Street establishment. Others interested in Sea Island cotton, and representatives of the Press, were also invited to the display and to the luncheon afterwards given by Mr. Austin Reed, at which speeches were made by Sir Philip Cunliffe-Lister (now Lord Swindon), Mr. Austin Reed, and others. Due publicity was given in the Press to the Secretary of

State's visit. Further publicity has been given by the issue of special communiqués to the Press, and by reference in the House of Commons to the steps being taken to promote the welfare of the Sea Island cotton industry. In addition, a broadcast talk on Sea Island cotton was given by Sir Algernon Aspinall.

The Advisory Committee has constantly kept in mind the holding of an exhibition of Sea Island cotton goods, but up to the present it has been considered that no good purpose would be likely to be served by an exhibition until a large and attractive range of goods was available. It was thought preferable to conserve resources which might be used to better advantage in this or other directions at a more appropriate time later on.

(ii.) THE WORK OF THE ASSOCIATION IN THE WEST INDIES.

At the time of the formation of the Association there were large stocks of Sea Island cotton lying unsold in the United Kingdom. It was considered necessary, therefore, that a policy of restriction of production should be adopted, and one of the most important functions of the Association has been the allocation of maximum amounts of cotton to be produced in the cotton-growing islands. The Association has had no means of enforcing restriction, but the policy has been adopted in all the islands except Montserrat, where the excuse that cotton cultivation is the one and only industry of the inhabitants has been offered as an explanation for producing in excess of their quota. Fortunately, however, the rapid increase in consumption and removal of surplus stocks which took place in 1935 relieved any awkward situation that might have arisen by reason of Montserrat's failure to limit her production to the recommended quota. The position in 1936 is that the demand is likely to keep pace with production, but the Association has not abandoned the policy of "controlled production." At its third annual general meeting in January, 1936, production allocations were agreed upon for each island, and no island is expected to exceed its quota without first obtaining the sanction of the Association.

Measures aiming at the control of the export of cotton have also been recommended by the Association. It was considered that some degree of restriction in the export of cotton lint on consignment was necessary, and to this end legislation has been introduced in several islands limiting the total amount which may be exported on consignment. In view, however, of the changed market conditions the system of controlling the export of cotton on consignment has been modified. In order to avoid the accumulation of surplus

stocks in the United Kingdom, a quota has been suggested for each island, fixing the amount of cotton which may remain unsold in the United Kingdom at any one time. Governments have been invited to enforce this recommendation by the introduction of legislation where necessary.

In addition to the advertising campaign conducted and encouraged by the Advisory Committee in the United Kingdom, the Association has taken advantage of the limited field for advertisement in the West Indies. Advertisement booths containing articles of clothing made from Sea Island cotton have been staged at more than one island in places which tourists and other visitors frequent. The Association has also invited the Governments of the British colonies in the Caribbean area to remove the duty on goods made from Sea Island cotton entering those colonies for a period of three years, so that these goods may be retailed at a lower price, and thus introduce to a wider range of purchasers the attractive qualities of Sea Island cotton goods.

The Cotton Conference held in Trinidad in 1933 was regarded as the first annual general meeting of the Association. Since that meeting two annual general meetings have been held, one in Montserrat, in November, 1934, and one in St. Vincent in January, 1936. Also, nine meetings of the Executive Committee have been held. At these meetings, in addition to the several subjects to which reference has already been made in this article, the Association has recommended for adoption in all the cotton-growing islands the system of supplying cottonseed for planting purposes through a single channel, namely the Agricultural Department, a system which has worked successfully in St. Vincent for several seasons. Matters relating to grading, baling and wrapping cotton have also received the attention of the Association, and recommendations aiming at the standardization of bales within practical limits have been made.

In addition preliminary steps have been taken towards the establishment of an entomological service for the study and, if possible, introduction of more effective cotton pest control measures, and towards the appointment of a market intelligence officer in the United Kingdom to furnish the growers and exporters of cotton with the much needed information concerning marketing conditions. The Association has guaranteed funds for both of these prospective services. From all the foregoing it will be seen that much time has been expended on the preparatory work for the incorporation of the Island and Central Associations.

Received March, 1936.

THE ROLE OF INSECTS AND FUNGI IN AGRICULTURE

BY

SIR ALBERT HOWARD, C.I.E.

Formerly Director of the Institute of Plant Industry, Indore, and Agricultural Adviser to States in Central India and Rajputana.

A PERUSAL of the original papers to be found in the twelve volumes of the EMPIRE COTTON GROWING REVIEW which have appeared since 1924, and of the various publications of the Indian Central Cotton Committee since its inception, will show what a large proportion of the time and energy of the research workers has been devoted to the study of the insect and fungous pests which attack the cotton crops of the Empire.

If the excellent series of notes on current literature, which make this journal so useful to cotton workers overseas, be examined in detail, a similar conclusion will be reached. The cotton crop almost everywhere seems to come in for perhaps more than its fair share of pests. It would be interesting if figures could be published showing the total sums which have been spent in the British Empire since 1924 on the scientific investigation of cotton diseases, and also on the various remedial measures which have been adopted to control the various pests. The resulting figure would, I think, be astonishing.

When the Editor of this journal recently invited me to contribute an article on some subject of interest to cotton-growers, it occurred to me that I could not do better than sum up very briefly thirty years' experience of the diseases of cultivated plants, including cotton. During this period I have had first-hand experience in this branch of agricultural research in three continents—America, Asia and Europe—and have travelled widely.

THE DEVELOPMENT OF AGRICULTURAL RESEARCH

Let us consider for one moment how our existing research structure has arisen. As everybody knows, it is a comparatively modern development which started 100 years ago, when Boussingault laid the foundation of agricultural chemistry in 1834. The early

pioneers were all chemists. Liebig's classical monograph on agricultural chemistry appeared in 1840. Lawes started work at Rothamsted in 1843, when the great era of chemical investigation began which continued for fifty years. During this period agricultural science was a branch of chemistry. Gradually the conviction grew that the problems of crop production could not be solved by chemistry alone. Hilgard and King's work led to the growth of soil physics. Pasteur's work on fermentation laid the foundation of the modern work on micro-organisms and disease. During the last forty years the plant-breeding and disease phases, in which we are now living, have been added to a structure which has always grown by accretion rather than by the development of a well-considered plan. Agricultural science—like Topsy—has grown. The present system of Agricultural Colleges, Experiment Stations and district organizations (within the Empire), for bringing the results of research to the farming community, is a very recent development of little more than thirty years.

Now it is a well-understood principle in business that any organization which expands by accretion stands in urgent need of periodical examination to ascertain whether the results obtained correspond with the cost, and whether any modifications are needed in the light of increased knowledge and experience. I began such an investigation of the plant disease section of agricultural science in 1905, and have steadily carried it on since. After thirty years' work, I feel sufficiently confident of my general conclusions to place them before the research workers in cotton in the various parts of the world.

Perhaps the best way of describing my investigation is to proceed more or less in chronological order, and to explain the gradual evolution of the somewhat revolutionary views that I now hold.

I began research on agriculture in 1899, at the age of twenty-six, as a mycologist, after a long scientific training—three years at the Royal College of Science, London, and three years (mostly devoted to biology and chemistry), at Cambridge, where I took both parts of the Natural Science Tripos as well as the Diploma in Agriculture. My first real contact with plant diseases was in connection with sugar-cane and cacao in the West Indies. Almost at once I discovered a fundamental weakness in the research organization: the mycologist had no land on which he could take his own advice before talking to the planters about remedies.

My next post was botanist at Wye College, where I learnt much from Sir Daniel Hall, whose experiments on hops I took over, and with

whom I had many useful consultations. During my last year at Wye I had a small plot of land on which to grow a collection of fodder plants, but I had no hops on which I could try out certain ideas that were fermenting in my mind about the insect and fungous diseases of this interesting crop. It was only in 1905 at Pusa, in India, largely through the support of the Director, the late Mr. Bernard Coventry, that I had 75 acres of land on which I could grow crops in my own way, and study their reaction to insect and fungous pests and other things. My real education in agriculture then began—six years after taking my degree and obtaining all the paper qualifications and academic experience then needed by an investigator.

CROP MANAGEMENT AT PUSA

In 1905, at Pusa, at the beginning of the second and intensive phase of my education, I resolved to try out an idea (which first occurred to me in the West Indies), namely, to observe what happened when insect and fungous diseases were left alone and allowed to develop unchecked, and where indirect methods only, such as improved cultivation, were employed to prevent attack. Accordingly, nothing was done in the way of prevention: no insecticides and fungicides were used: no diseased material was ever destroyed. As my understanding of Indian agriculture progressed, and as my practice improved, a marked diminution of disease occurred. At the end of five years, in 1910, the attacks of insects and fungi became negligible, except in the case of a number of cultures whose root systems were afterwards found unsuitable for the soil conditions at Pusa. These were invariably attacked by disease, and I often had some difficulty in raising sufficient seed to maintain them from year to year. The advantage of these diseased plots in plant breeding was that they supplied abundant infecting material, such as rust spores, for testing the reaction of the rest of the cultures to fungous attack. My work at Pusa continued on these lines for an unbroken period of twenty years, during which hundreds of thousands of cultures were grown. The results, as far as insect and fungi were concerned, were consistent. Varieties which suited the local conditions, and which were properly cultivated, were always practically immune to disease. In the case of cotton, a crop which was grown for some years to determine to what extent cross-fertilization took place under Pusa conditions, it was evident that only the local North Bihar variety was able to withstand the large number of insect pests which found the great mass of Indian and American cottons such attractive

provender. In the damp climate of Pusa the cotton crop, generally speaking, acted as a veritable magnet for every type of insect pest.

Between the years 1910 and 1916 the wheat investigations at Pusa were developed considerably. It was necessary to try out the improved types at a number of centres on the alluvium all over the Indo-Gangetic plain, and also on the black soils of Peninsular India. An excellent opportunity of observing the reaction of these cultures to rusts, and the geographical distribution of the various fungi, occurred. It was found that any variety which would stand up to rusts in the damp climate of Pusa did much better in this respect when grown in the drier wheat-growing areas of India proper.*

SOIL AERATION AND DISEASE INCIDENCE AT QUETTA

For a period of eight years—1910 to 1918—I was provided with a subsidiary experiment station on the loess soils of the Quetta valley, where the effect of different methods of cultivation and irrigation on the incidence of the insect diseases of fruit trees was studied. I observed no fungous diseases of fruit trees of any importance in the dry climate of Quetta valley during the eight summers I spent there. On the grape gardens run by the people on the well-drained slopes of the valley I never observed any diseases—insect or fungous—on the vines, although they were planted in the floors of deep trenches, and allowed to climb up the earth walls, mostly on the shady side. Flavour, disease resistance and a well-drained subsoil all seemed to go together. The chief pest of fruit trees was green-fly soon after the young leaves appeared. This could be produced or avoided at will by careful attention to cultivation and irrigation. Anything which interfered with soil aeration brought on this trouble. Anything which promoted soil aeration prevented it. I frequently produced a strong attack of green-fly on peaches and almonds by over-irrigation during the winter and spring, and

* In 1910, in consequence of persistent importunity, I was allowed to have my own oxen at Pusa, and at once decided to make use of these animals for the study of disease. The greatest care was taken in the selection of the breed and of the type of animal; the feeding, hygiene, and management were as near perfection as I could make them.

I had my own oxen at Quetta and at Indore, and managed them on lines similar to those adopted at Pusa.

For twenty-one years—1910 to 1931—I was able to study the reaction of well-fed animals to the epidemic diseases such as rinderpest, foot and mouth disease, septicæmia, and so forth, which frequently devastated the countryside. None of my animals were segregated; none were inoculated; they frequently came in contact with diseased stock. No case of infectious disease occurred. The reward of well-nourished protoplasm was a very high degree of disease resistance, which might even be described as immunity.

then stopped it dead by deep cultivation. Young shoots were covered with the pest below, but the upper portions of the same shoots were completely healthy. The green-fly never spread from the lower to the upper leaves on the same twigs. These observations were confirmed at Pusa for several years in the case of *Lathyrus sativus*. At this centre soil aeration was of supreme importance, and only surface-rooted types could obtain sufficient air for their roots. Deep-rooted varieties never did well. In the case of *Lathyrus sativus*, all the deep-rooted varieties were invariably attacked by green-fly. The shallow-rooted types alongside were always immune. The *Aphides* were never observed to move from the deep-rooted cultures to the shallow-rooted types alongside.

EFFECT OF SURFACE DRAINAGE AND HUMUS SUPPLY ON COTTON

At the end of 1924 I left Pusa to take up the direction of the Institute of Plant Industry at Indore in Central India, where the main crop was cotton. On the black soils there it was found that the two factors on which the yield and well-being of the American and Indian varieties of this crop depended were soil permeability and a supply of humus. Surface drainage, combined with dressings of fermented organic matter, produced cotton crops which appeared to be practically immune to all the local insects and fungi. One experiment I was unfortunately unable to try, namely, the importation of a supply of the various cotton bollworms and boll-weevils from America, and the letting of these loose among my cultures. I offered to do this, however, when the question of the accidental importation of these pests into India was discussed. I am pretty certain that they would have found my cotton cultures very indifferent nourishment.

The contrast between the same varieties of Indian cotton when grown on the damp alluvial soils at Pusa and the dry, well-drained black cotton soils of Central India was most striking. Nothing could be done with cotton at Pusa on account of insect pests on the one hand and waterlogged soil on the other. For these reasons the large scale attempts to grow cotton in North Bihar in 1905 had to be abandoned. At Indore, during the seven years I was there, I cannot recall a single case of insect or fungous attack, although a large number of varieties were grown every year, and the area under cotton always exceeded one hundred acres. The local cotton pests studiously avoided my cultures. I concluded they did not provide these pests with the nourishment they needed.

CONCLUSIONS REGARDING PATHOLOGICAL RESEARCH AND PRACTICE

So much for my general experience of the diseases of cultivated plants. My conclusions can be summed up as follows:

1. Insects and fungi are not the real cause of plant diseases, and only attack unsuitable varieties or crops improperly grown. Their true role in agriculture is that of censors for pointing out the crops which are imperfectly nourished. Disease resistance seems to be the natural reward of healthy and well-nourished protoplasm. The first step is to make the soil live by seeing that the supply of humus is maintained.

2. The policy of protecting crops from pests by means of sprays, powders and so forth is thoroughly unscientific and radically unsound; even when successful, this procedure merely preserves material hardly worth saving. The annihilation or avoidance of a pest involves the destruction of the real problem; such methods constitute no scientific solution of the trouble but are mere evasions.

3. The protection of an area from imported pests is fortunately almost impossible to carry out in practice on account of the rapid improvement of communications and the increasing volume of traffic. If the present regulations were really effective, they would be harmful in that we should be deprived of a portion of the censors which Nature has provided for keeping our agriculture up to the mark.

It follows from these conclusions that the current views on diseases will have to be modified. This can only take place when the Empire possesses a number of entomologists and mycologists who have developed into real agriculturists and horticulturists, more or less on the lines I have indicated above. We shall then have a body of wide experience—scientific and practical—on these questions. Two things will have to be done before such workers are available:

- A. The system of training in pathology will have to be improved and widened. The future investigators of plant diseases, after a broad training in science, will have to learn agriculture, and to satisfy practical men that they possess real aptitude in growing crops.

- B. The facilities for research in vegetable pathology will have to be vastly improved. Our future entomologists and mycologists will have to be provided each with a small experiment station on which they can grow crops and *on which practical growers can see for themselves workable solutions of their disease troubles*. Incidentally, the volume of the annual reports will be severely curtailed, as the details of life histories and nomenclature will naturally become of very minor interest and importance.

Applying these considerations to the cotton crop, it is obvious that it is impossible to alter suddenly, by a stroke of the pen, as it were, the general policy now in operation with regard to the diseases of cotton. It must take a good many years before the insect and fungous pests of this crop can be regarded as censors for indicating something amiss either with the variety, with the general environment, or with methods of cultivation. During this intermediate period, I suggest that steps should be taken, wherever possible, to encourage mycologists and entomologists to grow cotton for themselves, and to become fully conversant at first hand with all the details of practical agriculture in the localities in which they are working. This is the first step on the new road. The next thing in the investigation of any particular disease will be for the workers themselves to try to ascertain the nature of the precise factor or factors which have altered the cotton plant and made it attractive to the pest.

Working on these lines in India, I always found the appearance of insects and fungi on my cultures most useful and most stimulating. These organisms were my best teachers; without them I should never have grasped the real factors underlying agriculture, and should have been a most unsuccessful plant breeder. I should never have devised the Indore method for the conversion of agricultural wastes into humus.

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GRADING OF IMPROVED ISHAN COTTON IN THE SOUTHERN PROVINCES OF NIGERIA

BY

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IN the Southern Provinces of Nigeria cotton is grown by peasant farmers as a catch-crop, generally in mixed cultivation with the main food crops (yams, maize, etc.). A proportion of the crop is used for spinning and weaving locally, but the greater part is exported; it is with the export-crop that this article is concerned.

The work of the Agricultural Department has included the improvement of the local Ishan cotton by the plant breeders. Seed of this cotton was first available for sale to farmers in the Southern Provinces of Nigeria in 1927, and the results have proved so successful that Ishan has now almost completely replaced the native variety. From 1928 onwards no native seed has been distributed, and any native cotton sold for export has been grown from seed kept back by the farmer himself. During the period of depression, from 1931 to 1933, practically no native seed cotton was brought in for sale for export, and only sufficient was grown for use in local industries. The increased export of native cotton in 1934 and 1935 was derived from seed saved from these sources; with the rise in price farmers extended their acreage of cotton by sowing any seed they could obtain, although Ishan seed was available for purchase throughout the season.

The following figures indicate the replacement of native cotton by Improved Ishan in the export from Southern Nigeria. Figures are given in bales of 400 lb. of lint.

<i>Year.</i>					<i>Improved Ishan.</i>	<i>Native.</i>
1927-28	...	...	...	...	68	3,867
1928-29	...	...	...	...	939	6,371
1929-30	...	...	...	...	6,026	2,699
1930-31	...	...	...	...	4,289	312
1931-32	...	...	...	...	1,330	4
1932-33	...	...	...	...	861	5
1933-34	...	...	...	...	2,884	118
1934-35	...	...	...	...	5,208	389

Under the Cotton Regulations cotton intended for export can only be purchased, after grading, at certain cotton markets gazetted each year by Government, at each of which markets an official Cotton Examiner is stationed throughout the cotton season.

When Improved Ishan was first introduced it was considered that the grades then existing for native cotton could be applied also to Ishan. These grades were:

Grade I. ...	... 11 per cent. by volume	} Of stained, damaged, or immature.
Grade II. ...	... 33 per cent. by volume	
Grade III.	... No limit	

In addition to the percentage of defects stated above, Grade I. and Grade II. had to be "of the necessary standard as regards freedom from leaf and foreign matter." Cotton is brought to the market by the producer or middleman and is graded outside the market. Each consignment is first inspected for broken leaf and foreign matter; representative samples are then taken throughout the heap, thoroughly mixed, and an estimate made of the percentage by volume of the defects. A grading slip is issued to the owner showing the grade of that parcel. The cotton is then taken into the market, where firms' buyers are stationed, and is weighed, paid for at the ruling price for that grade, and the weight entered on the grading slip. At the end of the day the Cotton Examiners collect the grading slips respecting cotton bought by each firm's buyers, check the total weight purchased by each firm, supervise bagging, and seal the bags before removal from the markets. A certificate is then issued to the firms for the total weights and grades purchased that day.

The method of determining the percentage of defects was as follows: From the mixed representative samples from the heap nine closed handfuls were taken and carefully picked over. If less than one handful of defective cotton was found the cotton was classed as Grade I. and similarly more than three handfuls as Grade III.

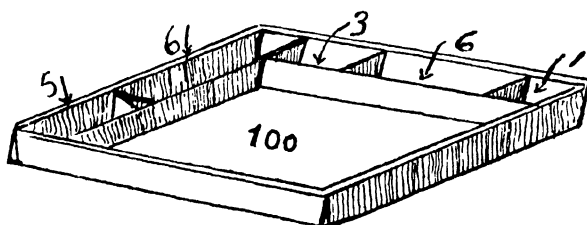
Experience from 1928 to 1931 showed that we were unable to maintain the requisite high standard of Improved Ishan cotton by the application of the native cotton grades. The British Cotton Growing Association brought to our notice a specific instance of a number of bales of Improved Ishan where, after arbitration, a decreased price had to be accepted owing to the presence of an excess of immature and stained cotton and broken leaf. Accordingly new grades for Ishan cotton were introduced in 1931, and were first enforced for the 1932 crop. These new grades were:

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				<i>Stained or Damaged.</i>	<i>Immature.</i>	<i>Native Cotton.</i>
Grade I.	...	...	...	1 per cent.	5 per cent.	Nil.
Grade II.	...	...	...	6 per cent.	6 per cent.	1 per cent.
Grade III.	...	...	...	No limit	No limit	3 per cent.

In addition, as under the old grades, both Grades I. and II. had to be "of the necessary standard as regards freedom from leaf and other foreign matter."

In order to ensure a more accurate estimation of the percentages of defects, grading trays were introduced and provided at each cotton market. These trays were 1 inch deep, and were divided into six compartments. The surface areas of the compartments were 100, 6, 6, 5, 3, and 1 square inches respectively, the main division (10 by 10 inches) being large enough to contain a double handful of seed cotton spread out in a layer one lock deep.



A double handful of cotton is taken from the mixed representative samples from the heap and spread out in the main compartment; defective locks are then picked out and placed in the smaller compartments. The percentage content by volume of each defect is thus estimated, and the cotton graded according to the limits laid down. The percentage of each year's crop falling into the three grades is given in the following table

Old Grades:				<i>Grade I.</i>	<i>Grade II.</i>	<i>Grade III.</i>
1928	...	...	...	89	2	10
1929	...	...	...	74	24	2
1930	...	...	...	85	15	0
1931	...	...	...	97	3	0
New Grades:						
1932	...	...	...	17	26	57
1933	...	...	...	2	10	88
1934	...	...	...	1	4	95
1935	...	...	...	1	1	98

It will be seen that the result of the introduction of the new grades has been to place almost the whole crop into Grade III. It is probable that the figures for 1932 do not represent the correct classification of that year's crop, since the Cotton Examiners were not then accustomed to the new method of grading or skilled in the

use of the grading trays, and probably much of the Grades I. and II. in that year would have been accurately classified as Grade III. It was the opinion of Officers supervising the work of the Cotton Examiners that a large proportion of the Grade III. cotton had to be placed in that grade solely on account of what we then considered would be the reduction in value due to immaturity. Many bags of Grade III. appeared to be of greater value than that grade suggested, and the range between the cleanest and dirtiest was unreasonably wide.

It appeared that the new grades—or our instructions to the Cotton Examiners as to the classification of “immature” and “stained”—were unduly severe on the producer, since, in spite of careful harvesting and care of his crop, he had but little chance of obtaining more than Grade III. price, however clean his cotton.

In 1934 it was considered desirable to send home some lint samples in order to obtain information about the effect that “immature” cotton, as we recognized it, had on the commercial value of the lint. Samples of lint ginned from seed cotton containing known percentages of “stained” and “immature” were therefore sent home for brokers’ valuation and spinning tests. The results indicated that the variation in the commercial value of the lint depended only on the “stained” content.

In 1935 this experiment was repeated. To ensure accuracy regarding the defective content, and also to ensure that the “immature” locks, as we recognized them, were in no way discoloured or stained, artificial mixtures of seed cotton were very carefully prepared covering a wide range of stained and immature cotton.

These were as follows:

		<i>Stained.</i>	<i>Immature.</i>			<i>Stained.</i>	<i>Immature.</i>
A	...	0	0	F	..	20	0
B	...	5	5	G	..	0	20
C	...	10	0	H	..	20	20
D	...	0	10	K	..	40	0
E	...	10	10	L	..	0	40

The preparation of these artificial mixtures of seed cotton was carried out in the following way. In order to be able to use an ordinary gin for each sample (Platts double rib huller gin with air blast) at least three and a half bags of each mixture of seed cotton were necessary. Thirty-five bags of Grade I. Ishan from the 1935 crop were very carefully picked over, and any locks showing the slightest trace of discoloration or immaturity were removed. Five bags each of “stained” and “immature” were then picked out from a large number of bags of Grades II. and III.

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The unit of volume used in measuring was a tin bowl about 10 inches in diameter and 4 inches deep. In preparing sample B (5 per cent. stained and 5 per cent. immature) eighteen bowls of clean cotton were spread out on a clean floor, and one bowl each of stained and immature distributed over it. A gang of boys thoroughly mixed this up, until a double handful tested on the grading tray showed the mixture to be uniform. This process was repeated and the next twenty bowls of mixture bulked with the first, mixed and again tested. This mixing and testing continued until there was sufficient of the "B" mixture to fill four bags. Before bagging, final tests were made independently by two Cotton Examiners under exact commercial conditions. The other nine samples were made in the same way, varying the "stained" and "immature" content as required. The ten mixtures of seed cotton were then ginned and a 10 lb. sample taken from the middle of each heap of lint. Each sample was sewn up in baling canvas and the ten pressed into a composite bale and despatched to the Empire Cotton Growing Corporation for brokers' and spinners' opinions and spinning tests. The reports on the 1935 samples (appended), though not completely devoid of inconsistencies, confirm those of 1934, and leave no room for doubt that what we have called "immature" cotton in the Southern Provinces is not defective in a practical commercial sense.

It is proposed to modify the instructions given to Cotton Examiners in the 1936 season with regard to the recognition of "stained" and what is properly "immature" cotton, and so bring our grading more in accordance with the real value of the cotton. After the experience of the 1936 crop we shall be in a position to consider whether it is desirable to amend the present regulation. Extracts from the brokers' report and comments by the Spinning Tests Committee on the 1935 samples are given in Appendix I. Appendix II. gives the results of the Lea Tests and the general Report on the Spinning Tests made by the British Cotton Industry Research Association.

APPENDIX I.

Sample.	Per Cent. Stained.	Per Cent. Immature.	Grade, Length of Staple, and Remarks.	Strength of Staple.	Value (Pence per Lb.).	Comments by the Spinning Tests Committee.
G	0	20	Strict Good Middling— $1\frac{3}{8}$ inches— good colour	Strong	7-10d.	The best sample. Very slightly spotted. Silkier and finer than others— $1\frac{1}{2}$ inches staple.
D	0	10	Strict Good Middling— $1\frac{3}{8}$ inches— creamy colour	Strong	7-00d.	Very slight stain. A little longer than B and C, but a little softer.
A	0	0	Strict Good Middling— $1\frac{3}{8}$ inches— creamy colour	Medium to strong	6-95d.	Nice grade; no stain, good staple, full $1\frac{3}{8}$ inches, a bit woolly.
L	0	40	Good Middling to Strict Good Middling— full $1\frac{1}{2}$ inches—very slight stain	Medium to strong	6-90d.	Very mixed. Slight spot, neppy, dull— $1\frac{1}{2}$ inches.
C	10	0	Barely Good Middling—full $1\frac{1}{2}$ inches— rather high colour. Rather spotted with stain	Medium	6-85d.	Very similar to B in grade and staple, but a little more stain than B.
B	5	5	Strict Middling—full $1\frac{1}{2}$ inches irregular —spotted with stain	Medium	6-70d.	More stain than A, but only slight. Good staple, but mixed.
E	10	10	Middling to Strict Middling—full $1\frac{1}{2}$ inches—high colour spotted with stain	Medium	6-60d.	Much stain. Mixed in staple. Woolly— $1\frac{1}{2}$ inches.
F	20	0	Middling to Strict Middling—full $1\frac{1}{2}$ inches—much spotted with stain, high colour	Medium	6-50d.	Worse than any sample from A to E. Neppy. Irregular and very spotted. Worth 100 points off A.
H	20	20	Middling—full $1\frac{1}{2}$ inches—generally stained	Medium	6-40d.	Similar to F, but staple slightly better.
K	40	0	Low Middling—Good $1\frac{1}{2}$ inches—stained throughout	Soft	6-00d.	Very poor—mixed, very badly stained; 200 off G.

Values based on: (Futures) July Futures, 6-50d.
Values based on: (Spot), Middling American, 6-90d.

NOTE.—Columns 4, 5, and 6 are extracts from the Report on these samples by the brokers to whom they were sent, dated July 6, 1935. Column 7 gives the comments by the Spinning Tests Committee before the spinning tests were carried out at the Shirley Institute.

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APPENDIX II.

THE BRITISH COTTON INDUSTRY RESEARCH ASSOCIATION. COTTON TEST REPORT No. 169.

LEA TESTS.

Sample.	Actual Count.	Lea Strength (Lb.).	Coefficient of Variation		Count × Strength.	Actual Count.	Lea Strength (Lb.).	Coefficient of Variation		Count × Strength.
			Ct.	L.S.				Ct.	L.S.	
		32's Spin nings.					40's Spin nings.			
A	32.7	50.7	1.9	3.6	1,658	40.0	36.6	3.7	10.3	1,464
B	31.6	52.1	2.1	7.0	1,646	40.4	34.3	2.0	8.6	1,386
C	32.1	52.2	2.0	6.2	1,676	39.2	36.5	1.9	5.2	1,431
D	31.6	52.6	2.6	6.9	1,662	40.1	34.6	2.9	8.9	1,387
E	32.2	47.8	2.2	7.7	1,539	38.7	36.5	3.2	7.5	1,413
F	32.7	49.1	2.4	6.3	1,606	39.4	39.2	2.7	5.5	1,544
G	31.6	51.3	4.1	6.5	1,621	40.0	35.3	3.3	9.8	1,412
H	31.7	51.1	3.6	8.0	1,620	39.5	38.4	3.1	6.6	1,517
K	31.2	51.2	2.8	8.2	1,597	40.1	35.4	2.1	6.4	1,420
L	32.0	45.5	2.8	7.8	1,456	39.4	36.2	2.2	6.5	1,426

SPINNING TESTS.—Most of the samples gave good card webs, but sample K was the worst in this respect and showed considerable nep. Subsequent processing was normal, except that the twist in the roving had to be increased above the normal for 8 hank, probably on account of the high hair-weights per centimetre of the samples. Spinning was good in 32's and fairly good in 40's.

STRENGTH.—The samples are very similar to each other in yarn strength, and, judged by the standard applicable to counts below 40's, are suitable for spinning into warp counts from 36's to 40's.* The comparatively low strengths obtained are no doubt a consequence of the high hair-weights per centimetre of the samples.

APPEARANCE.—The yarns were placed in the following orders for appearance:

30's.
G Very good.

C }
H } Good.
D }

F } Fair.
L }

K Bad colour.

A Fair.

E } Ordinary.
B }

40's.

A)
C)
B) Good.
H)
G)

D)
F) Fairly good.
L)

E Ordinary.

K Poor, bad colour, blotchy.

* Lea Count-Strength product of 1,560 for 40's.

THE ORGANIZATION OF THE NATIVE STAFF ON AN AFRICAN EXPERIMENT STATION

With some details of the way in which plant breeding and general experimental work is carried out at Barberton.]

BY

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Cotton Experiment Station, Barberton.

THE efficiency and economy of running a modern agricultural experiment station in the tropics, where technical work is carried out on an extensive scale, depend very largely on the careful training and organization of the native staff which performs the numerous manual operations. A wide experience has been gained at Barberton, and the following gives some account of the various practical problems which confront the plant breeder, and the way in which they are dealt with.

The order of intelligence of the native population from which it is possible to recruit employees in the Barberton district is on the whole rather low. The position is aggravated by the relatively high wages paid to natives on the mines, which absorb quite a proportion of the better-class labour. The Swazi tribe predominates, whilst a sprinkling of Zulus, Portuguese and Nyasaland boys are to be found in the vicinity. The term "boy" applies to any male native from the young lad stage upwards.

On a large-scale experiment station such as that at Barberton, a large gang of boys of good physique is necessary for the general field operations of planting, hoeing, cultivating, reaping of rotation crops, threshing and other general farming work. This gang is constantly changing in personnel as boys leave and others are taken on, and from it the plant breeder has to draw his labour for the more precise work with which he is concerned.

By experience one gets to know the respective qualities of individual natives. For example, one native may be reliable for running a message quickly or always bringing the correct article when sent to fetch something; another may be good at sitting on his haunches and doing neat work with his fingers; one may learn to read plot numbers easily; whilst another may perform herculean

feats of lifting—for instance, carrying a heavy pack of valuable seed cotton back to the shed when a storm is approaching and no wagon is available; another may be good with oxen or machinery. In time one gets to know just which boys to take out for any particular job.

Apart from boys, a gang of native women is employed on the station during the growing and picking season. Generally speaking, it is easier to find intelligent native females than males. This is judging from the fact that when any counting or reading of numbers is to be done by natives one seems automatically to send for the female element.

The planting of variety trials and single-plant selections is the season's first operation needing careful organization of labour. At Barberton about five gangs of six natives each do the work under the vigilant eyes of an officer aided by a European lay assistant. There are generally a fair number of raw natives, but the gangs are arranged with a sprinkling of old hands in each. Planting is done by hand, using a system of cross wiring (cable wire with linen tapes accurately spaced along it). Speed, accuracy in depth of planting, number of seeds put in per hill, and quick and clean changing of seed between plots are important factors, and the ability to learn and reliability of new boys can soon be discerned. Planting is an excellent "trial run" for new boys.

A point of interest, perhaps, is that the design of variety trial at present in vogue at Barberton comprises a randomized block experiment in two parallel series, commonly with thirteen strains and six or twelve replications, depending on whether two- or four-row plots are used, and covering an area of approximately two and a half acres. Two gangs of six boys each will plant such an experiment in about two and a half hours with good tilth conditions.

Planting over, the general native gang is occupied in hoeing and cultivating for a while, and then begins the serious work on single plants. It is at this time that the gang of native women is recruited.

The original selections in the various families on the single plant block are made just before flowering becomes general. The process of selfing these plants is carried out by the native women under a white supervisor. About fifteen women are employed, and carry out the operation after two o'clock in the afternoon, when the flower buds are fully extruded and easily visible above the bracts. The fact that the buds are then quickly perceived means that the plants are not pulled about in the search for them, and remain comparatively undamaged by the selfer's hands. Each plant is visited once every day whilst flowering is in progress. Here again discrimination is

necessary, and a daily record is taken of the particular plots which each woman tends. Inefficiency is easily spotted on the day subsequent to selfing, by the flowers which have opened normally instead of remaining closed by the retaining wires which should have been placed over them. The individual responsible is further instructed, and if she still proves unreliable, is paid off. A further cause of discrimination in the female gang is that the larger, more developed females are technically less suited than the slimmer "ntombazanes" (young girls), as they are liable to damage the plants when squatting between them to place the selfing wires!

A note on the actual method of selfing employed at Barberton may be of interest. Spiral cones of fine copper wire are made by wrapping the wire round a suitably carved piece of wood, leaving a straight piece extending about two and a half inches from the base of the cone. The cone is then slipped over the flower-bud, the straight piece of wire being pushed through the subtending bract and secured loosely round the peduncle, or, if the latter is short, round the fruiting branch itself. In this way the cone gently resists upward pressure, and is further prevented from slipping sideways when the bud withers owing to the wire passing through the bract. Special care should be taken towards the end of the season—when the flower-buds are of a smaller size than early-season buds—not to secure the wire at all tightly, as the base of the cone, if pressed closely against the young fertilized boll, may cause lesions in it. The presence of a wire over set bolls is then a sure indication that the flower has been satisfactorily selfed. After a few days the wire cones are removed by a small gang of trained boys, who place red wool round the peduncles of the selfed bolls. During this part of the season these boys are constantly engaged in removing wire cones and reshaping them for further use, thus effecting an economy in wire.

The native women are employed by the day, and when they are not selfing, other employment is found for them. For instance, during a bollworm attack it is quite feasible for the women to visit each of the single plants every morning, picking off "flared" squares, thus trapping many small worms, whilst the large worms of later instars are often seen feeding in exposed positions ~~on~~ the plant and are picked off. This worm collection, although naturally an impossible procedure in the crop as a whole, is well worth while with single plant selections, as only from undamaged plants can a correct idea of ultimate yield be obtained. A plant which loses its early formed bolls through bollworm may put on a good crop higher up the plant later in its life, but its habit will

then be completely altered from what it would have been in the undisturbed state.

Other part-time employment for the selfing gang is found in "witch weed" (*Striga lutea*) pulling. In land where it is present in the soil this parasite of maize is usually flowering at the time of year at which selfing is taking place in cotton. Hand pulling of the witch weed plants as they appear proves a useful control, and the operation fits in economically from the labour point of view.

During the growing season a record of the relative progress of various strains is obtained from daily counts of the flowers produced by them (*vide* "Progress Reports from Experiment Stations, 1934-35," p. 14). Formerly young European lads employed locally did this work, but this season native women equipped with mechanical tally counters carried it out efficiently under the supervision of one European. The native girls proved capable of working and actually accurately reading the tally counters.

The next phase of the season's work is picking, and here particularly careful organization and supervision is necessary.

With the single plant selections the crop is taken—separately for each plant, in several pickings as the bolls open—into linen bags, inside each of which is a brown paper bag. The former hold any naturally fertilized seed cotton, whilst into the latter is put the material from bolls which have been selfed. As no selfing is done on Sundays, and also owing to the fact that the selected plants will have set a certain number of bolls before selfing could be started on them, there will always be a certain amount of natural seed; this is picked as a safety reserve, and may or may not be used. To each linen bag is affixed a brass ring through which a larger wire ring is threaded, the various families being conveniently kept in groups in this way. A gang of about four boys with one or two European supervisors do the actual picking, and a few of our present natives, considering their actual level of intelligence, have become surprisingly conversant with the method of cataloguing plants, sequence of plots and plants, and general procedure. Naturally they have to be well drilled in the business of keeping selfed and natural seed separate, and only one bag is allowed to be opened at any one time. The contents of all clean, well-opened bolls are wrapped in squares of tissue paper (citrus wrappers are used), so that an accurate bollweight can later be obtained in the laboratory.

The picking of cotton variety trials involves the vigilant supervision of a large gang. Frequently picking cannot begin until well on in the day, owing to the heavy dews experienced in May, June

and July, so that speed is again necessary, as it is usually difficult to clear the opening cotton sufficiently quickly. Also once one has started to pick an experiment it is very desirable to finish it on the same day, so that conditions may be comparable over the whole trial. Should it prove impossible to complete the work in one day, it is at least essential to finish any block which has been commenced. From the statistical point of view picking by blocks should be satisfactory, but if an over-night rain occurred, picking might be delayed for a week, which would be very undesirable. Each native picks his line of cotton into a petrol tin, putting the contents out on to a sack which has been placed on the ground at the end of his plot. From this mat other natives eventually take up the whole picking for the plot. This is immediately weighed on a spring balance hanging from a tripod which is moved down the field as the picking proceeds. The seed cotton from the variety trial plots is then bulked, the seed after ginning being used as cattle rations. Picking a variety trial is usually quite a rapid business, and needs extremely careful watching, for with about forty men and women native pickers of mixed intelligence moving in and out of plots, one has to be on the look-out for the odd black sheep who, ever and anon, tries to put his picking on the wrong mat !

Lots which are being carried on as bulks are picked in similar fashion to a variety trial, with the exception that all seed must be kept and bagged separately at once. This means that several pickings have to go into one bag, and to get these bags out of the field as methodically and quickly as possible the pickers are lined up, given a bag or several consecutive bags each and marched to the field in single file, dropping the bags in order as they come to the plots. After picking they are again lined up and marched back in order to the seed store, where the bags are methodically stored in readiness for the next picking, or ultimately, at the end of the season, for ginning. In this way much time is saved by averting re-sorting of bags, and the pickers are kept in high spirits as they find the procedure most entertaining.

Another process involving the training of natives is the preparation of seed-cotton samples for lint measurements. Samples are taken from variety trials for each picking, and the combing of these is started as soon as the first pickings come in. By the time the single-plant samples are ready, the natives doing this work will have attained some facility and are able to perform the task really well. Something like fourteen thousand seeds may have to be combed during a season, and about four or five boys are usually constantly employed on this



FIG. 1.



FIG. 2.



FIG. 3.



FIG. 4.

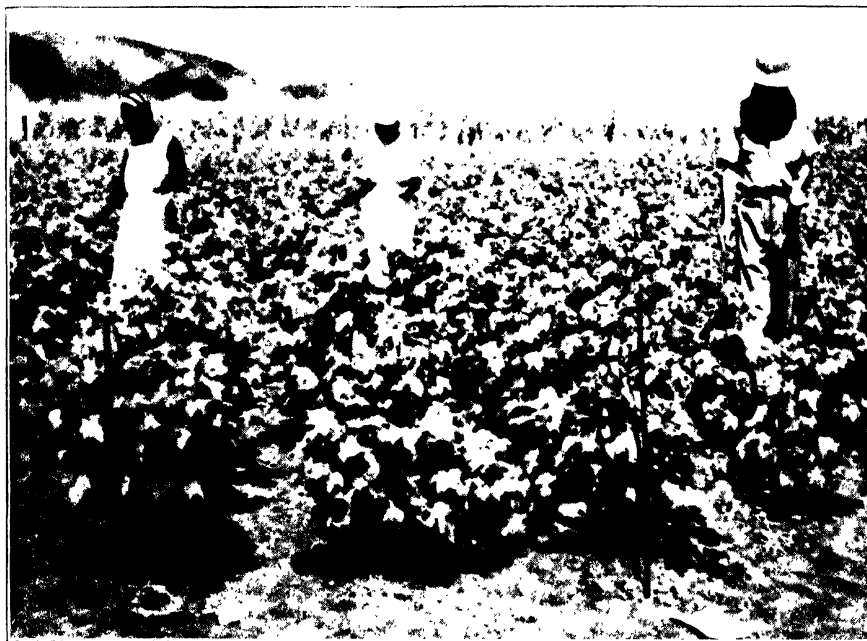


FIG. 5.

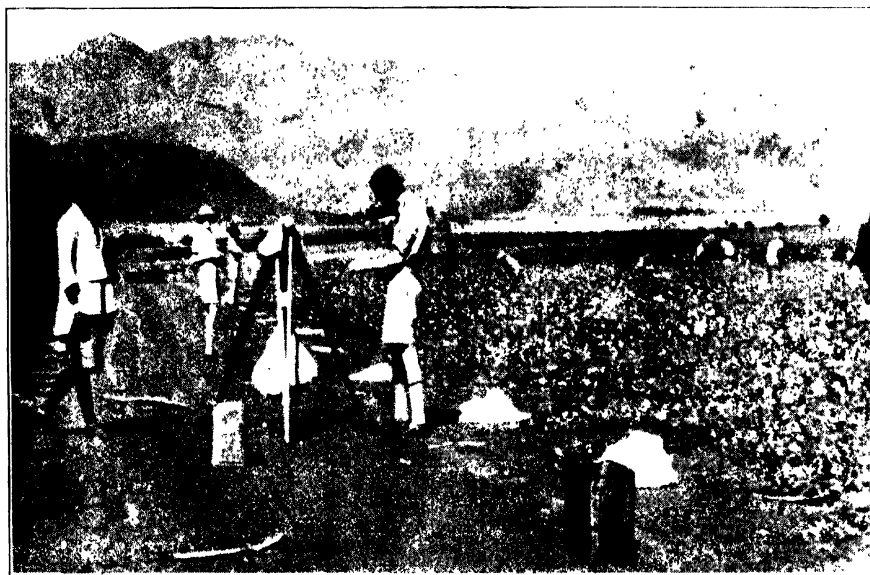


FIG. 6.



FIG. 7.

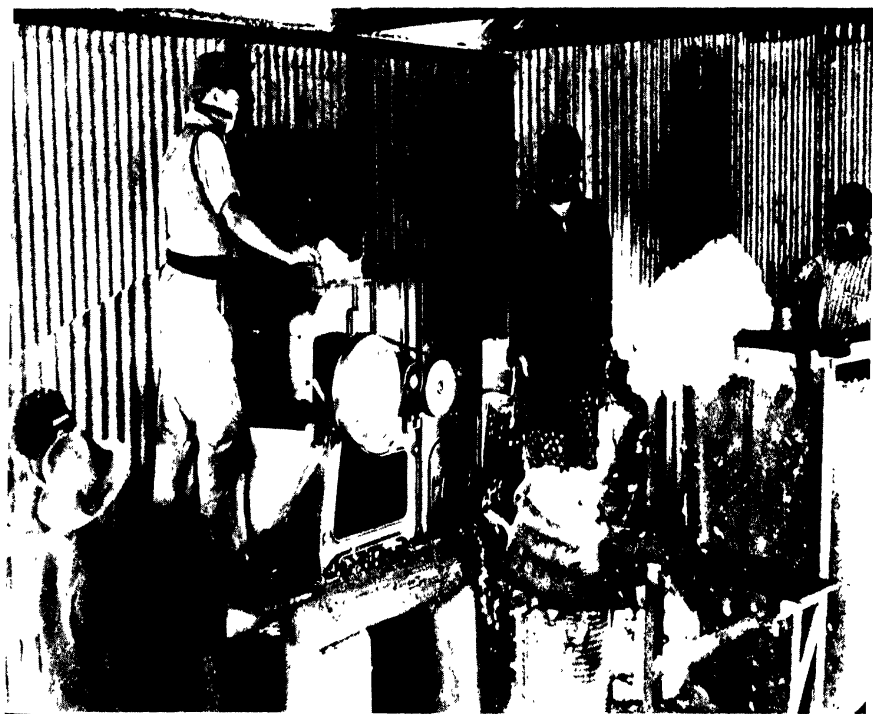


FIG. 8.

work for a period of six weeks to two months each season. With natives of any sort of manual ability at all this is one of the most easily taught operations, possibly because it is a sedentary occupation and provides illimitable scope for a good chat—the African native is a gregarious animal, and thoroughly enjoys social intercourse !

The final task of the season on which the native staff is employed is ginning. The single plants are ginned on a small roller gin, whilst the larger bulks are put through an electrically operated 40-saw gin. With the ginning of bulks, the natives soon become used to the routine of putting each lot of seed back into its correct bag and also to the process of carefully cleaning the gin between each lot, though the operation is always carefully supervised by an officer.

In a hundred and one ways the officer engaged in plant breeding and general field experiments can save himself time and trouble by the careful organization of available labour, and, profiting by experience, increase the efficiency of his work. Nothing has been said here about the use of natives in the insect pest control work, but the officers concerned on this side could most certainly tell tales of doughty deeds done by African employees in recording the laying of bollworm eggs in the cotton and maize fields, and searching for stainers on the myriad host plants of this pest which exist in the veld.

Our natives are, on the whole, a pleasant lot of people to work with, having a happy disposition and an inveterate sense of humour, but a little boot leather or a smart rap with the stick is not wasted on them on occasion !

EXPLANATION OF PLATES

FIG. 1.—Native woman placing selfing wire.

FIG. 2.—Close up, showing flower bud fully extruded and easily visible above bracts.

FIG. 3.—Method of attaching wire round fruiting branch. Taken about thirty-six hours after placing of wire.

FIG. 4.—Method of attaching wire round peduncle.

FIG. 5.—Native women, with European supervision, using mechanical tally counters whilst taking flowering records in a cotton variety trial.

FIG. 6.—Picking a variety trial. Weighing in progress in the foreground, with white supervisors watching the placing of pickings on the correct mats in the distance.

FIG. 7.—After picking multiplication bulk plots. Lining up the pickers in order for the return to the seed store, as explained in the text.

FIG. 8.—Ginning small bulks on the electrically-driven 40-saw power gin. Whilst seed is separately bagged the lint is bulked and sent to the local ginnery for baling, and eventually sale.

COTTON STATISTICS

BY

JOHN A. TODD, M.A., B.L.

World's Crops.—The chief interest in our first table is the evidence which it offers of the steady increase of Outside Growths, while the American crop is still being kept down by Government restriction. In order to put this movement in its proper perspective we give here a summary of the world's crop history at five-year intervals since 1914, which it may be recalled was a record year, and the outstanding fact is that while in 1914 America produced 16,135,000 bales (excluding linters) and Outside Growths amounted to 11,220,000 bales, this year the position is just about reversed with American at 10,638,000 bales and Outside Growths 16,388,000 bales; but the total in 1935 is a little less than in 1914.

WORLD'S CROPS—SUMMARY.

(500 LB. BALES, EXCEPT INDIA.)

	1914.	1919.	1924.	1929.	1934.	1935.
U.S.A. (except linters) ...	16,135	11,421	13,628	14,825	9,637	10,638
India	5,209	5,796	6,088	5,243	4,858	5,728
China	2,333	2,470	2,104	2,055	3,030	2,309
Egypt	1,298	1,114	1,455	1,706	1,511	1,707
Russia	1,244	200	458	1,279	1,744	2,493
Brazil	456	463	649	564	1,309	1,539
Mexico	125	200	221	240	223	235
Turkey	120	100	77	120	161	203
Peru	118	159	198	266	336	370
British Empire	76	87	288	330	581	599
Korea, etc.	37	92	122	137	224	239
Argentine	3	15	75	138	258	295
Smaller crops	201	191	276	323	608	671
Total Outside Growths ...	11,220	10,887	12,011	12,401	14,843	16,388
Grand Total	27,355	22,308	25,639	27,226	24,480	27,026

To get the full meaning of the increase of Outside Growths, however, it is necessary to note the grouping of the various countries into large, medium and small producers, and into old-established and new countries. The old-established countries are of course America, India, Egypt, Brazil, Mexico, and Peru, and only the last

three of these have shown much relative increase. China had only begun to be an important cotton-growing country a few years before the war, but 1934 was a new record. Russia also had just exceeded a million bales for the first time in 1913, but her crop was drastically cut down by the war, yet she is now disputing with China the position of third largest producer. Brazil has made tremendous strides in the last three years, and is now producing almost as much as Egypt; in fact, some of the estimates indicate that she may do so this year.

But the most significant point is the number of countries (including the British Empire, apart from India, as one unit) which were producing negligible quantities in 1914, but have now reached substantial totals. For reasons of space the table includes only those countries which are now producing crops of more than 200,000 bales, but there are a great many other smaller countries which have shown an almost equal rate of progress—*e.g.*, the Belgian Congo. The point is that the increase of Outside Growths is very widespread; and if America continues her policy of crop restriction there is no reason why the total of Outside Growths should not continue to increase at the rate of about a million bales per annum.

American Crop.—The March figures are given in the lower half of the table, and it will be seen that they made very little difference on the December estimates, except that the crop was again reduced by nearly 100,000 bales, which meant that the crop estimate had been reduced in every single Bureau since August. The final figures published in May are given in the upper half of the table, and again as expected show only minor revisions of the March figures. It will be noted that the December acreage figures showed a pretty heavy reduction from the earlier estimates.

Indian Crop.—The detailed figures now available of the distribution of the Indian crop by varieties between long and short staple bear out our anticipation in the April issue that the percentage of long staple cottons would prove to be the highest of recent years, but it is difficult to say whether it is actually a record owing to the fact referred to a year ago that the Indian Central Cotton Committee had revised the distribution of the crops by transferring “Barsi and Nagar” and “Salem” from long to short staple. Even the table as it now stands is not quite complete, because at a later date in each season the Committee publish a more detailed statement in which they allocate parts of the Broach and other long-staple crops to short staple and of the C.P. Oomras crop to long staple. These, however, cancel each other out to some extent. The increase of long

staple this year is largely due to the record crops of American cotton in Punjab and Sind, and the recovery of the Broach crop.

Egyptian.—The Government's final estimate of the Egyptian crop in June should be received in time to be included in this table, but, judging from the ginning returns up to the end of March, it is not likely to show much variation from the December estimate of 8,445,000 kantars formerly used.

The Egyptian Carryover has been moving quite normally throughout the season, and looks like being substantially less than it was at the end of last season. That, of course, is fairly obvious with a crop of only about 8,500,000 kantars and consumption during the first half of the season still running at the rate of about 9,000,000 kantars. The figure at the end of the season might therefore be as low as 3,000,000 kantars, though as a matter of fact the actual computed Carryover at the end of the season seldom coincides with the calculated figure. In any case the outstanding fact is that it looks like showing a reduction of the Carryover for the fifth year in succession.

Consumption.—The Federation's half-yearly figures of Consumption and Stocks appeared, as we had anticipated, without either the German or Italian figures, and with, as is now usual, only an estimate for Russia. This makes it very difficult to know what to do with the figures. Without Germany and Italy comparisons would be futile, but no sort of official estimates are available, and the only thing we can do in the meantime is to use again as the basis of an estimate last year's U.S.A. figures for Germany, which, however, were only for the full season with no details for the two half-years. Even this, however, requires modification, for it is known that last season Germany was using a tremendous quantity of Brazilian which has not been repeated to the same extent this year. We have therefore had to make an arbitrary reduction from the U.S. estimate of Germany's consumption of Sundries (from 598,000 to 200,000 bales, which is still more than double Germany's former normal consumption of Sundries). For Italy we have simply repeated the figures of last January. All this is very unsatisfactory, but as the total consumption of All Kinds in Germany and Italy is now probably less than 2,000,000 bales per annum, it is not likely that the probable error in the estimates will make very much difference in the comparative totals.

These comparisons are very significant. In the first place, the world's consumption of All Kinds for the half-year was apparently 13,388,000 bales, which is very near to a record total, for the highest

figure ever recorded was 13,411,000 bales in the second half of 1926-27. Of the total, 6,212,000 bales were American and 7,176,000 Outside Growths. As it happens the figures for the two halves of last season were almost identical both for American and Outside Growths, so that the position may be put in this way, that the consumption of American is fully half a million bales more than last year, while that of Outside Growths shows almost no reduction at all. There is still, therefore, no sign of any big swing back in consumption from Outside Growths to American. What is happening is simply that American is regaining some of the ground which it had lost, while Outside Growths are holding their own.

Rather more than half of the increased consumption of American is in the U.S.A., but every other division except Asia has shared in the increase. As will be seen from our next table the increase in America has continued since January, and it may be noted that Garside's estimate of the world's consumption to the end of April was 9,424,000 bales of American and 10,961,000 of Outside Growths, so that Outside Growths are still leading by a very substantial margin.

Prices.—Since our last issue there has been a definite recovery of prices in the American market, though the quotations are still well below the highest of the season, but well above the lowest of August and September. It is important to recall that in the early months of the season the American authorities seemed to be basing their loan arrangements on a figure of about 10 cents, but since then, as the result of their handling of the Pool cotton, as described in our special article in the April issue, the price has been forced up again to something nearer the level of 12 cents for spot cotton, and now under the new arrangements for the disposal of the 4½ million bales held under the 12-cent loan they have practically fixed 11·25 cents as the minimum. The importance of this is that the American authorities have been forced to modify their policy of last August, which was to let the American crop find its way freely into commercial channels at a moderate price. Now they are still willing to let it go, but at a distinctly higher level of prices, which has once more placed Outside Growths in a favourable position to compete with American.

The result may be seen in our last table, which shows the spot prices of other varieties as percentages of American, from which it appears that the relative prices of Outside Growths have fallen back again since about December, and this is mainly due to the renewed rise in the price of American. The fall is greatest in the case of Indian owing to the confirmation of the larger crop.

WORLD'S COTTON CROPS.

(BALES OF 500 LBS.—000's.)

	1930-31.	1931-32.	1932-33.	1933-34.	1934-35.	1935-36.
U.S.A. Lint	13,932	17,096	13,002	13,047	9,637	10,638
Linters	986	1,067	912	982	1,001	1,000
Total	14,918	18,163	13,914	14,029	10,638	11,638
Mexico	174	203	99	255	223	235
Brazil	471	575	438	958	1,309	1,539
Peru	265	228	237	278	336	370
Argentine	136	165	146	206	258	295
Other South American	57	46	39	76	70	100
India*	5,226	4,007	4,656	5,108	4,858	5,728
China	2,386	1,733	2,195	2,652	3,030	2,309
Japan, Korea, etc. ...	147	99	133	197	224	239
East Indies, etc. ...	18	15	13	14	20	20
Russia	1,589	1,846	1,776	1,917	1,744	2,493
Persia	64	107	79	181	200	200
Iraq, Ceylon, etc. ...	3	1	†	†	2	4
Asia Minor and Europe	120	131	68	191	258	345
Egypt	1,655	1,271	991	1,715	1,511	1,707
Sudan	96	188	110	126	237	193
East Africa (British)	166	183	269	274	273	322
South Africa (British)	8	3	2	3	3	4
West Africa (British)...	15	5	20	23	47	52
Non-British Africa ...	125	96	121	156	192	190
West Indies (British)...	4	2	2	3	4	4
West Indies (Others)...	21	31	26	23	30	23
Australia, etc.	10	4	11	18	14	16
World's Total	27,674	29,102	25,345	28,403	25,481	28,026
Outside Growths	12,756	10,939	11,431	14,374	14,843	16,368
Per cent. on Total	46·1	37·6	45·1	50·6	58·3	58·5

Government estimate, 400 lb. bales.

† Less than 500 bales.

AMERICAN CROP (EXCLUDING LINTERS).

	1930-31.	1931-32.	1932-33.	1933-34.	1934-35.	1935-36.
Acreage planted (000's)	43,339	39,109	36,542	40,852	27,883	27,888
Acreage harvested ...	42,454	38,705	35,939	29,978*	26,987	27,335
Crop (running bales)...	13,756	16,629	12,710	12,664	9,472	10,420
Yield per acre (lbs.)...	157.0	211.5	173.3	208.5	170.9	186.3
Season's average spot price (Liverpool—pence per lb.) ...	5.71	4.82	5.62	6.02	6.93	—

PROGRESS OF THE SEASON 1935-36.

	August.	Sept.	Oct.	Nov.	Dec.	March.
Acreage planted ...	29,166	29,166	29,166	29,166	27,872	27,872
Acreage harvested ...	28,480	28,652	28,652	28,652	27,331	27,331
Crop (500 lb. bales) ...	11,798	11,489	11,464	11,141	10,734	10,635
Yield per acre (lbs.)...	198.3	192.0	191.5	186.1	188.0	186.0

* Less 10,396,000 acres special abandonment.

INDIAN—AREA AND CROP BY VARIETIES.

Varieties.	1933-34.			1934-35.			1935-36.		
	Area.	Crop.	Yield per Acre.	Area.	Crop.	Yield per Acre.	Area.	Crop.	Yield per Acre.
<i>Mainly under ½" Staple:</i>									
Oomras, Khandesh	1,116	274	98	1,152	239	83	1,280	290	91
Central India ...	1,766	213	48	1,806	189	42	1,804	304	67
Barsi and Nagar	2,346	376	64	2,074	306	59	2,419	412	68
Berar ...	2,948	506	69	2,915	443	61	2,861	437	61
Central Prov. ...	1,322	212	67	1,286	174	54	1,299	209	64
Total ...	9,498	1,581	67	9,233	1,351	59	9,663	1,652	68
Dholleras ...	2,386	570	96	2,965	599	81	1,952	424	87
Bengal Sind*	3,999	1,234	123	3,847	1,328	138	3,638	1,337	147
Comillas, Burmas, etc. ...	578	142	98	592	131	89	611	143	94
Coconadas ...	170	24	56	184	30	65	166	28	67
Salems ...	200	37	74	181	33	73	176	32	73
Total under ½" ...	16,831	3,588	85	17,002	3,472	82	16,206	3,616	89
Per Cent. of Grand Total	69.7	70.8	—	70.8	71.5	—	64.5	63.1	—
<i>Mainly ½" and above:</i>									
American, Punjab	809	364	180	841	398	189	1,541	746	194
" Sind ...	184	61	133	211	86	163	385	155	161
Broach ...	1,283	228	71	1,384	148	43	1,346	307	91
Coompta-Dharwars	1,362	185	54	1,167	146	50	1,439	180	50
Westerns & North-erns ...	1,770	206	47	1,454	139	38	2,152	269	50
Tinnivellies ...	575	130	90	551	132	95	543	134	99
Cambodias ...	346	153	177	546	208	152	548	209	153
Hyderabad-Gaorani	976	153	63	864	129	60	978	112	46
Total ½" and above...	7,305	1,480	81	7,021	1,386	79	8,932	2,112	95
Per Cent. of Grand Total	30.3	29.2	—	29.2	28.5	—	35.5	36.9	—
Grand Total ...	24,136	5,068	84	24,023	4,858	81	25,138	5,728	91

United Provinces, Rajputana, Sind, Punjab, etc.

EGYPTIAN CROP.

	1930-31.	1931-32.	1932-33.	1933-34.	1934-35.	1935-36.
Area (feddans, 000's) ...	2,082	1,683	1,094	1,804	1,732	1,669
Crop (kantars, 000's):						
Alexandria adjusted arrivals ...	7,917	6,563	5,050	8,438	7,540	8,100†
Government figures *	8,276	6,357	4,956	8,575	7,556	8,535
Average yield (kantars per feddan)* ...	3.97	3.78	4.53	4.75	4.36	5.11

Season's Average Spot Prices (Liverpool—Pence per Lb.).

Sakel ...	9.06	6.80	7.79	8.05	8.52	—
Percentage on American	33.6	41.1	38.6	33.7	22.9	—
Uppers ...	6.86	5.68	7.01	6.64	7.57	—
Percentage on American	20.1	17.8	21.7	10.3	9.2	—

* Final revised figures, including Scarto.

† November estimate, already exceeded by actual arrivals.

WORLD'S CARRYOVER OF EGYPTIAN COTTON

(KANTARS 000's.)

End of	Stock and Afloat.		U.S.A.		Alex- andria.	Monthly Totals.	Federation. Other Mill Stocks.	Half- Yearly Totals.*
	U.K.	Conti- nent.	Mills.	Ware- houses.				
1929, July ...	510	150	449	197	1,677	2,983	1,260	4,243
1930, January	<i>535</i>	<i>270</i>	<i>353</i>	<i>202</i>	<i>3,403</i>	<i>4,813</i>	<i>1,335</i>	<i>6,148</i>
July ...	353	135	483	245	3,616	4,832	1,297	6,129
1931, January	<i>630</i>	<i>293</i>	<i>341</i>	<i>129</i>	<i>5,349</i>	<i>6,742</i>	<i>1,185</i>	<i>7,927</i>
July ...	600	165	212	108	4,452	5,541	1,418	6,959
1932, January	<i>1,013</i>	<i>248</i>	<i>145</i>	<i>63</i>	<i>5,521</i>	<i>6,990</i>	<i>1,447</i>	<i>8,437</i>
July ...	885	203	161	180	3,780	5,209	1,553	6,762
1933, January	<i>878</i>	<i>218</i>	<i>134</i>	<i>171</i>	<i>4,255</i>	<i>5,656</i>	<i>1,425</i>	<i>7,081</i>
July ...	742	202	131	143	2,228	3,446	1,635	5,081
1934, January	<i>1,507</i>	<i>337</i>	<i>142</i>	<i>106</i>	<i>3,157</i>	<i>5,249</i>	<i>1,687</i>	<i>6,936</i>
July ...	1,132	248	174	135	1,491	3,180	1,868	5,048
1935, January	<i>968</i>	<i>435</i>	<i>132</i>	<i>100</i>	<i>2,230</i>	<i>3,865</i>	<i>2,242</i>	<i>6,107</i>
July ...	533	285	130	110	546	1,604	1,965	3,569
August	420	233	124	99	443	1,319	—	—
September	353	165	110	86	689	1,403	—	—
October	525	518	106	73	1,318	2,540	—	—
November	675	577	113	68	1,996	3,429	—	—
December	825	405	104	79	2,319	3,732	—	—
1936, January	<i>690</i>	<i>383</i>	<i>98</i>	<i>87</i>	<i>2,368</i>	<i>3,626</i>	<i>2,078</i>	<i>5,704</i>
February	750	233	107	92	2,241	3,423	—	—
March	728	345	112	97	2,149	3,431	—	—
April ...	630	308	111	103	1,913	3,065	—	—

Figures in *italics* to distinguish between mid-season and end of season.

WORLD'S CONSUMPTION OF COTTON.

(FROM THE STATISTICS OF THE INTERNATIONAL FEDERATION.)

(Running Bales, 000's—Excluding Linters.)

Variety.	Season.	U.K.	Continent.	U.S.A.	Asia.	Others.	Totals.
<i>American.</i>	1930-31	991	3,242	5,084	1,315	239	10,901
	1931-32	1,342	3,343	4,744	2,636	251	12,316
	1932-33	1,400	3,836	6,004	2,655	276	14,171
	1933-34	1,461	3,976	5,553	2,238	306	13,534
	1934-35	1,049	2,782	5,241	1,997	285	11,354
	1935-36*	647	1,502	2,947	961	157	6,212
<i>Indian.</i>	1930-31	252	1,215	43	4,318	35	5,863
	1931-32	183	727	21	3,834	23	4,788
	1932-33	126	600	16	3,455	23	4,220
	1933-34	234	844	14	3,638	42	4,772
	1934-35	312	889	22	4,501	18	5,772
	1935-36*	190	484	25	2,126	9	2,834
<i>Egyptian.</i>	1930-31	242	420	70	96	25	853
	1931-32	301	480	53	120	26	980
	1932-33	301	412	58	104	29	934
	1933-34	366	515	69	119	39	1,108
	1934-35	362	552	55	185	41	1,195
	1935-36*	181	292	23	91	20	607
<i>Sundries.</i>	1930-31	479	1,984	42	1,648	711	4,864
	1931-32	560	1,730	26	1,133	786	4,235
	1932-33	421	1,797	32	1,922	856	5,028
	1933-34	409	2,137	33	2,154	964	5,697
	1934-35	754	3,099	19	2,456	1,152	7,480
	1935-36*	312	1,500	6	1,282	615	3,755
<i>All kinds.</i>	1930-31	1,964	6,861	5,239	7,407	1,010	22,481
	1931-32	2,386	6,280	4,814	7,723	1,086	22,319
	1932-33	2,248	6,675	6,110	8,136	1,184	21,353
	1933-34	2,470	7,472	5,669	8,149	1,351	25,111
	1934-35	2,507	7,322	5,337	9,139	1,496	25,801
	1935-36*	1,348	3,778	3,001	4,400	801	13,388

* First half-season.

U.S. CONSUMPTION OF COTTON BY VARIETIES.

(RUNNING BALES 000's: "FOREIGN" IN EQUIVALENT 500-LB. BALES.)

1934-35.	Total.	Daily Rate.	Upland.	American Egyptian.	Egyptian.	Other Foreign.	Linters not Included.
August ...	420.9	18.3	409.4	0.8	7.8	2.9	61.2
September ...	296.0	15.0	289.3	0.3	4.5	1.9	54.7
October ...	520.3	22.9	506.6	0.9	10.4	2.5	57.4
November ...	477.1	22.2	465.1	0.8	8.5	2.7	51.4
December ...	413.5	21.8	403.5	0.8	6.8	2.5	52.1
January ...	546.8	24.0	534.3	0.9	8.7	2.9	61.8
February ...	478.3	24.2	467.1	0.7	7.3	3.1	62.8
March ...	481.1	22.9	469.6	0.8	6.9	3.8	66.8
April ...	462.8	21.3	450.8	1.1	6.8	4.1	70.3
May ...	469.2	20.6	458.8	1.4	5.7	3.4	65.5
June ...	385.9	19.3	376.8	1.3	4.6	3.2	61.9
July ...	391.8	17.8	382.0	1.3	4.7	3.8	62.1
1935-36.							
August ...	408.4	18.6	397.9	2.0	4.7	3.9	57.9
September ...	449.1	21.4	437.6	1.8	5.5	4.2	61.1
October ...	552.2	24.0	538.5	2.0	6.4	5.3	67.1
November ...	507.8	24.8	496.1	1.8	5.2	4.8	59.5
December ...	408.3	26.2	487.3	1.8	5.5	3.7	55.2
January ...	591.3	26.0	578.1	2.2	6.6	4.4	56.0
February ...	516.6	25.8	504.2	1.9	5.6	5.0	53.6
March ...	548.9	25.0	536.9	1.8	5.0	5.3	60.8
April ...	576.8	26.5	562.7	1.7	5.8	6.6	61.4

HIGHEST AND LOWEST FUTURES PRICES.

1934-35.	<i>American.</i>				<i>Egyptian (Liverpool).</i>			
	<i>New York.</i>		<i>Liverpool.</i>		<i>Sakel.</i>		<i>Uppers.</i>	
	<i>High.</i>	<i>Low.</i>	<i>High.</i>	<i>Low.</i>	<i>High.</i>	<i>Low.</i>	<i>High.</i>	<i>Low.</i>
November	12.66	12.02	6.80	6.45	8.85	7.99	7.58	6.97
December	12.72	12.44	6.89	6.64	8.79	8.46	7.64	7.38
January ...	12.75	12.27	6.94	6.75	8.72	8.51	7.75	7.56
February	12.73	12.26	6.88	6.68	8.58	8.36	7.58	7.38
March ...	12.49	10.25	6.97	5.95	8.61	7.69	7.65	6.70
April ...	11.90	10.83	6.54	5.97	8.16	7.86	7.34	6.87
May ...	12.19	10.95	6.56	6.29	8.16	7.86	7.47	7.16
June ...	11.58	10.56	6.17	5.74	7.91	7.62	7.03	6.66
July ...	11.80	11.30	6.28	6.12	7.89	7.67	7.10	6.97
1935-36.								
August ...	11.60	10.31	6.22	5.63	7.86	7.58	7.04	6.42
September	10.81	10.31	5.97	5.52	8.01	7.48	6.82	6.38
October ...	11.27	10.54	6.21	5.77	8.42	7.78	6.87	6.51
November	11.97	10.86	6.54	6.07	9.51	8.44	7.77	6.82
December	11.77	11.01	6.49	6.14	9.20	8.57	7.71	7.28
January ...	11.58	10.90	6.24	5.77	9.22	8.54	7.53	7.03
February	10.99	10.63	5.87	5.62	8.81	8.29	7.14	6.84
March ...	11.34	10.59	6.08	5.66	8.76	8.34	7.20	6.90
April ...	11.31	10.80	6.11	5.83	8.72	8.45	7.18	6.94
May ...	11.58	11.02	6.13	5.93	8.68	8.48	7.30	6.95

Maximum and minimum figures in each season are given in italics.

LIVERPOOL SPOT PRICES OF AMERICAN WITH OTHER VARIETIES
AS PERCENTAGES (LAST FRIDAY OF EACH MONTH).

1934-35.	<i>American (Middling). Pence per Lb.</i>	<i>Indian No. 1 Fine Omtra.</i>	<i>West African (Middling).</i>	<i>Brazil.</i>		<i>East African (Good Fair).</i>	<i>Tanguis (Good).</i>	<i>Uppers (F.G.F.).</i>	<i>Sakel (F.G.F.).</i>
				<i>Pernam (Fair).</i>	<i>San Paulo (Fair).</i>				
November	6.96	70.7	98.1	95.3	96.0	106.8	114.7	108.8	129.3
December	7.20	73.8	98.2	95.4	96.1	107.9	113.5	109.4	124.2
January ...	7.08	77.5	98.6	95.8	97.9	109.9	113.4	112.6	127.1
February	7.10	77.5	99.3	96.5	98.6	110.6	113.4	107.3	124.8
March ...	6.36	80.3	99.5	96.4	98.7	112.1	114.5	116.8	130.3
April ...	6.78	82.2	99.3	96.3	98.5	111.1	113.3	117.1	124.6
May ...	6.92	77.7	97.1	94.9	97.1	107.2	109.4	109.8	117.9
June ...	6.85	80.0	98.5	96.4	98.5	108.8	109.5	108.2*	117.2
July ...	6.80	81.8	100.0	96.3	98.5	106.6	108.8	108.5	118.7
Season's average	6.93	75.6	98.7	95.5	97.4	108.4	113.6	109.2	122.9
1935-36.									
August ...	6.21	76.0	100.0	95.2	97.6	106.4	108.9	114.2	128.0
September	6.40	78.6	100.0	96.1	98.4	105.5	109.4	112.3	133.1
October ...	6.47	84.7	100.8	98.5	100.8	109.3	117.0	107.3	140.8
November	6.59	87.3	101.8	99.5	101.8	111.7	119.3	120.2	153.9
December	6.41	87.8	101.6	100.0	102.3	114.8	119.5	120.1	148.8
January ...	6.14	82.9	101.6	100.0	102.4	113.8	121.2	119.1	157.8
February	6.04	82.3	100.8	99.2	101.7	111.6	121.5	116.9	149.5
March ...	6.44	78.6	100.0	96.9	100.8	110.1	119.4	114.4	142.9
April ...	6.62	76.6	100.0	97.0	100.8	109.8	118.9	112.5	138.2
May ...	6.64	72.6	99.2	94.7	99.2	106.0	118.1	113.6	130.6

* New Contract.

EMPIRE COTTON CROPS FOR THE YEARS 1925-35, EXCLUDING INDIA
(In bales of 400 lbs.)

The seasons are given as covering two years (e.g., 1926-1927) because in the majority of the countries named planting takes place in one calendar year and picking in the next. In a few of these countries, however (e.g., Tanganyika, Cyprus, Malta and some of the West Indian Islands), the crop is harvested in the same year as that in which it is planted. In such cases the figures should be read as relating to the crop grown and harvested in the latter of the two years at the head of the column.

COUNTRY.	1924-25.	1925-26.	1926-27.	1927-28.	1928-29.	1929-30.	1930-31.	1931-32.	1932-33.	1933-34.	1934-35.
(1) Anglo-Egyptian Sudan ..	44,912	121,131	148,118	126,115	161,536	157,769	120,310	234,964	137,384	157,625	296,131 (1)
(2) Uganda ..	106,038	180,859	131,728	138,486	204,037	129,969	191,305	203,265	294,828	285,986	253,242 (2)
(3) Kenya ..	2,250	2,046	1,232	1,241	1,984	1,518	737	1,735	4,277	6,750	8,774 (3)
(4) Tanganyika ..	21,724	24,280	15,966	32,954	27,785	23,135	11,351	18,039	30,834	39,009	58,548 (4)
(5) Nyasaland ..	7,718	4,976	2,792	4,470	6,095	9,331	4,203	5,067	5,942	10,713	21,006 (5)
(6) N. Rhodesia ..	379	506	32	17	—	—	—	—	—	—	— (6)
(7) S. Rhodesia ..	4,907	6,803	639	90	280	1,481	1,974	579	355	689	566 (7)
(8) Union of South Africa and Swaziland	16,936	20,381	10,242	11,013	9,774	16,213	8,123	2,801	1,860	2,440	2,966 (8)
(9) Nigeria ..	39,137	47,909	27,464	20,930	32,126	43,925	18,850	6,268	24,366	28,212	58,850 (9)
(10) Gold Coast ..	1,132	1,218	285	264	296	200	297	263	68	144	146 (10)
(11) Cyprus ..	3,320	4,614	2,110	2,146	3,520	4,718	2,865	1,119	913	1,865	5,214 (11)
(12) Malta ..	782	507	342	541	379	293	201	41	34	32	20 (12)
(13) Iraq ..	2,540	3,500	1,800	5,200	4,700	3,300	960	409	*	—	— (13)
(14) Ceylon ..	121	261	186	202	380	248	95	47	34	92	124 (14)
(15) Queensland ..	14,318	7,179	5,880	10,266	6,296	13,999	12,228	4,975	13,903	21,924	17,653 (15)
(16) Fiji ..	123	824	356	114	271	398	266	90	8	39	29 (16)
(17) West Indies ..	4,186	5,941	6,076	4,088	5,312	5,672	5,106	2,524	2,614	3,618	4,720 (17)
	360,523	432,935	355,248	358,137	464,791	412,169	378,873	482,186	517,420	559,138	727,989
	Percentage Increase 36.9	Percentage Increase 20.0	Percentage Decrease 17.9	Percentage Increase 0.8	Percentage Increase 29.7	Percentage Decrease 11.3	Percentage Decrease 8.0	Percentage Increase 27.2	Percentage Increase 7.3	Percentage Increase 8.0	Percentage Increase 30.2

* No longer included in Empire figures.

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

357. INDIAN CENTRAL COTTON COMMITTEE. (*Ann. Rpt. to August 31, 1935.*)

A detailed and valuable report of much important work in connection with the following: The possibility of growing long-staple cottons in the present short-staple areas; legislation for the better growing and marketing of cotton; agricultural and technological research; publicity and propaganda work to popularize improvements of scientific and practical interest; statistical information useful to trade. Keen interest was taken in the efforts of the Lancashire Indian Cotton Committee to increase the consumption of Indian cottons in Lancashire, which resulted in the United Kingdom taking 393,784 bales, as compared with 361,546 bales in 1933-34. The Cotton Transport Act and the Cotton Ginning and Pressing Factories Act functioned satisfactorily in most districts.

In connection with research, funds were provided for thirty-eight research and other schemes, eight research students were under training, three in India and five abroad.

The Technological Laboratory at Matunga registered another successful year. The increased work handled by the laboratory necessitated the installation of additional machines and testing apparatus and the strengthening of the staff. At the Institute of Plant Industry, Indore, a beginning was made with the general distribution of the two new types of Desi cotton, Malvi 1 and Malvi 9, which have been found to yield 20 per cent. more than the local cottons. Agricultural investigations relating to the cultivation of cotton and other crops were continued.

358. INDIAN CENTRAL COTTON COMMITTEE. At the 32nd meeting, held on January 13 and 14, the following important matters were discussed: The successful work of the Lancashire Indian Cotton Committee in popularizing Indian cotton in Lancashire; the suggested legislation for the licensing of gins and presses in order to prevent malpractices such as excessive watering, and the mixing of different cottons; the elimination of Goghari cotton in important long-staple cotton areas; the causes of partial failures of the Punjab cotton crop. The Committee approved a number of new research schemes, and several existing schemes were extended for further periods. The report of the Cotton Forecast Improvement Sub-Committee and the progress report of the Director of the Technological Laboratory at Matunga were adopted.

359. INDIAN CENTRAL COTTON COMMITTEE. We have received from the Publicity Officer the following notices: *Improved Varieties of Cotton in Sind and their Cultivation*. The varieties recommended for cultivation are Sind Sudhar, Sind Sea Island, and Sind Boll III.

Sind and the Indian Central Cotton Committee. (W. J. Jenkins.) The main directions in which the committee has rendered financial assistance to cotton development in Sind are briefly described.

Improvement of Cotton in India. Discusses the seed distribution and extension schemes financed by the Committee with a view to increasing the area under improved varieties of cotton.

Save Indian Cotton. A circular stressing the need for the elimination of

Goghari cotton from its present position as the great adulterant of Navsari 1027 A.L.F. cotton.

360. INDIAN COTTON: STATISTICS. We have received from the Secretary, Indian Central Cotton Committee, copies of Leaflets Nos. 2, 3, and 4, giving information concerning the following: Stocks of Indian raw cotton held in India by the mills and the trade on August 31, 1935; receipts at mills in India of raw cotton classified by varieties, 1934-35 season; exports by sea of Indian raw cotton classified by varieties, 1934-35 season.

361. SPINNING TEST REPORTS ON INDIAN COTTONS, 1935-36. By N. Ahmad. (*Tech. Circs. Nos.* 209-12, 220-224, 1935-36. Ind. Cent. Cott. Comm.) The circulars contain the grader's report and spinning test results for Ujjain (Ujjain), Ujjain (Mandsaur), Bengals, Khandesh, and Moglai cottons, and the report of the Standards Committee and spinning test results for Nanded, C.P. No. 1, Latur, Punjab-American, and Muttia cottons for the 1935-36 season.

362. TECHNOLOGICAL REPORTS ON STANDARD INDIAN COTTONS, 1935. By N. Ahmad. (*Tech. Bull. No.* 28, Ser. A, 1935. Ind. Cent. Cott. Comm.) The reports contain the results of tests on standard cottons of the twelve seasons 1923-35. As in former years, the agricultural details, grader's report, fibre particulars, spinning tests, and remarks are given for each of the twenty varieties tested. Four new cottons are included—two from Sind (Sudhar and N.R.), and two new selections of C.P. Verum 262. Fifteen out of the twenty cottons show an improvement over last year, two have given practically the same result, while three show falling off. The cottons showing improvement are: Jayawant, Gadag 1, Sind N.R., 4F, Mollisoni, C.402, Verum Nagpur, Verum Akola, V. 434 Akola, Late Verum Nagpu., Umri Bani, Co. 2, Nandyal 14, Hagari 1, Karunganni C.7.

363. TECHNOLOGICAL REPORTS ON STANDARD INDIAN COTTONS, 1935-36. By N. Ahmad. (*Tech. Circs. Nos.* 208, 214-219, 1935-36. Indian Cent. Cott. Comm.) The particulars given include agricultural details, grader's report, fibre particulars, spinning tests, remarks, and conclusions.

Punjab-American 289F.—Area under cultivation 56,200 acres. Rather neppy. The 1935-36 sample suitable for 44's warp.

Verum 262 (Nagpur).—Area under cultivation 78,550 acres. The strength of the yarns was below the average in 1935-36. Suitable for 23's warp.

Verum 262 (Akola).—Area under cultivation 78,550 acres. Suitable for 20's warp.

V. 434 (Akola).—Area under cultivation 5,065 acres. Slightly neppy. Suitable for 31's warp.

Late Verum (Nagpur).—Area under cultivation 18,500 acres. Slightly neppy, but gave good spinning performance. Suitable for 33's warp.

Umri Bani.—Area under cultivation 937,370 acres. Slightly neppy, but gave good spinning performance. Suitable for 34's warp.

Punjab-American 4F.—Area under cultivation 769,700 acres. Suitable for 26's warp.

364. TECHNOLOGICAL REPORTS ON TRADE VARIETIES OF INDIAN COTTONS, 1935. By N. Ahmad. (*Tech. Bull. No.* 29, Ser. A 1935. Ind. Cent. Cott. Comm.) The grader's report and spinning test results are given for 26 representative trade varieties of cotton supplied by the East Indian Cotton Association, 19 varieties supplied by the Bombay Mill-owners' Association, and 3 by the Ahmedabad Mill-owners' Association.

365. COTTON RESEARCH IN INDIA. By N. Ahmad. (Ind. Cent. Cott. Comm., 1936. Price Rs. 2.) A very interesting account of the work done at the Indian

Central Cotton Committee Technological Laboratory from 1924 to 1935. The various sections deal with: The history and objects of the Technological Laboratory; fibre tests and research on cotton fibre and yarn; spinning tests and technological research; moisture content of India cottons and allied problems. A list of publications is included at the end.

366. INDIAN COTTON INDUSTRY: TARIFF INQUIRY EVIDENCE. (*Ind. Text. J.*, **46**, 1935, p. 84. From *J. Text. Inst.*, xxvii., **4**, 1936, A195.) Evidence given to the Special Tariff Board appointed to hold an enquiry regarding the level of duties necessary to afford adequate protection to the Indian cotton textile industry against British piece-goods and yarns, is reported in full. Memoranda by Indian and Lancashire interests are also presented. Indian mill-owners urge the retention of the existing scale of duties, but the Lancashire delegation, supported by the Chambers of Commerce and Indian importing interests, desire a 25 per cent. reduction of the Indian customs duty on British piece-goods.

367. INDIAN TEXTILE INDUSTRY: ORGANISATION. By A. M. Patel. (*Ind. Text. J.*, **46**, 1935, p. 23. From *J. Text. Inst.*, xxvii., **2**, 1936, A91.) The requirements of the Indian textile industry for establishment on a satisfactory basis are discussed, the need for scientifically trained staff, efficient mill managers, adequately treated workers, and a central research station, especially for chemical problems, such as the Shirley Institute, being emphasized.

368. INDIAN TEXTILE INDUSTRY: PROGRESS, 1935. (*Ind. Text. J.*, **46**, 1935, p. 75. From *J. Text. Inst.*, xxvii., **4**, 1936, A195.) The progress made by the Indian textile industry during 1935 is briefly reviewed. There has been an all-round increase in the number of looms and spindles, and the opening of new mills in inland districts is a conspicuous feature. There are now 365 mills, with 9,686,000 spindles and 198,867 looms, employing 415,000 operatives.

369. LIST OF COTTON PRESSING FACTORIES, WITH NAMES OF OWNERS AND PARTICULARS OF MARKS ALLOTTED TO THEM IN THE DIFFERENT PROVINCES OF BRITISH INDIA AND CERTAIN INDIAN STATES, FOR THE SEASON 1935-36. (No. 2876. Obtainable: Manager of Publications, Delhi. Price As. 12 or 1s. 3d.)

370. INFLUENCE OF STORAGE ON SOME OF THE FIBRE PROPERTIES OF DHARWAR COTTON. By H. R. Nayak. (*Ind. J. Agr. Sci.*, vi., **1**, 1936, p. 52.) The experiments described refer to the controlled conditions of storage in the laboratory, where most of the harmful effects of micro-organisms and climate are eliminated. A small sample (2 lb.) of Dharwar 1 (1928-29) cotton was stored in a cupboard in March, 1929, for a period of three and a half years, and periodic tests were made at intervals of six months commencing from September, 1929. There was found to be no significant change in any of the three fibre properties—length, weight and strength—studied, but the colour changed to a small extent.

371. ELIMINATION OF GOGHARI FROM THE SURAT TRACT WILL RE-ESTABLISH THE REPUTATION OF NAVSARI COTTON. (*Ind. Cent. Cott. Committee*, 1936.) The evil of mixing cotton is discussed. With a view to stopping the practice the Government of Bombay have passed legislation prohibiting the cultivation of, trading in, or mixing of Goghari cotton with good quality cotton in certain areas of the Bombay Presidency. Contiguous to the Goghari tracts in the Bombay Presidency are similar areas coming under the administration of the Baroda State, and it is hoped that similar legislation will be passed in that State.

372. AGRA AND OUDH. Cotton Cultivation, 1934-35. (*Rpt. on Admin. of Dpt. of Agr.*, 1935.) Cotton was adversely affected by the heavy rains of August,

but partly recovered later. Prices for Bengals, the principal staple of the main cotton tract, were lower than in past years. Research work on the cottons of Bundelkhand, financed by the Indian Central Cotton Committee, has resulted in a number of types being evolved, some of which show promise of becoming useful cultivators' cottons of reasonable staple. C.520 cotton is definitely spreading as an improvement on Aligarh 19, but C.402 is going out of cultivation. A concerted plan of campaign against the pink bollworm has been suggested by the Indian Central Cotton Committee, since the failure to deal systematically with this pest is resulting in severe monetary losses annually to the cotton growers.

373. PUNJAB: *Cotton Cultivation, 1935.* (*Rpt. of Operations of Dpt. of Agr., 1935.*) The total area under cotton was 2,347,063 acres, of which 840,739 acres were under American and 1,506,324 acres under Desi cottons. This year 67 per cent. of the area under Desi cotton represented improved varieties. The Department completed experiments with two very promising new selections of Punjab-American cotton and it has been decided to issue 43F. to cultivators. The other strain, 38F., is more susceptible to jassid attack. A new strain of Desi cotton, Mollisoni No. 39, is also being recommended for cultivation.

Varietal, hybridization, irrigation, time of planting, and manurial experiments were continued. The small ginners provided by the Indian Central Cotton Committee continued to fulfil a most useful function in dealing with the small lots of the many plots of cotton under experiment; it has proved, in fact, an indispensable adjunct in cotton research.

The principal pests under study during the year were the cotton white fly, pink bollworm and the spotted bollworm. The major part of the cost of the investigations was defrayed by the Indian Central Cotton Committee.

374. VARIATION IN THE FIBRE-PROPERTIES OF SIMILAR STRAINS OF COTTON GROWN IN DIFFERENT TRACTS OF GUJARAT. By B. S. Patel and — Srinagabhushana. (*Ind. J. Agr. Sci.*, vi., 1, 1936, p. 63.) Gives the results of experiments carried out to ascertain the difference in fibre-length, fibre-weight per inch, and maturity percentage of five similar strains of cotton grown in Broach, Surat, and Viramgam.

375. SIND: *Cotton Cultivation, 1934-35.* (*Ann. Rpt. of Dpt. of Agr., Sind, 1934-35.*) The irrigation supply in the Barrage areas was generally satisfactory. An increased area was planted to cotton on both right and left banks, the total output being 272,520 bales, compared with 250,000 bales the previous year. On the whole the season was favourable to American cotton, but the Desi cotton did not do so well.

The research activities of the Department were concentrated on the improvement of staple varieties by selection and hybridization. The strain 289F-1 proved to be the most suitable as a general purpose cotton on both banks of the Indus. Physiological research was continued, especially in regard to the economics and technique of the application of irrigation water to the cotton crop, and the nutritional requirements of the crop at different stages of growth. The enquiries into the costs of cotton production and the extent of village consumption were continued during the year, and an examination was also made of the possibility of establishing a "reserve area" for long-staple cotton in Sind.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

376. The following reports have recently been received:

BRITISH GUIANA: Div. Rpts. of Dpt. of Agr., 1934.

FWI: Agr. Journal, 1935.

SOUTHERN RHODESIA: Rpt. of Secy. Dpt. of Agr. and Lands, 1935.

TANGANYIKA: East Afr. Agr. Res. Sta. Amani, Seventh Ann. Rpt., 1934-35.

UGANDA: Ann. Rpt. of Dpt. of Agr., 1934, Pt. II.

WEST INDIES: *St. Vincent* : Rpt. on Agr. Dpt., 1934.

377. BRITISH COTTON GROWING ASSOCIATION. The thirty-first Annual Report for the year ended December 31, 1935, contains much valuable information on the work of the Association in India and in other parts of the Empire. Full details are given of the work of the B.C.G.A. (Punjab) Ltd. The report calls attention, among other things, to the decrease of the American crop, the extension of the use of Indian cotton in Lancashire, and the work of the Advisory Committee for West Indian cotton. Sections devoted to individual countries follow, and attention is drawn to the increase of ginning facilities in Nigeria, and to the record quantity of seed distributed which totalled 4,961 tons. The importance of cotton to Uganda is emphasized by the statement that it provides 81.49 per cent. of the exports. In Nyasaland, where the Zambesi Bridge has been opened, cotton now occupies the second place in the list of exports. In conclusion it is stated that "with regard to Empire cottons, it is pleasing to be able to record that the trade in general is becoming much more conscious of the importance of these 'outside growths.' This is no doubt due to the increased quantities which are now available, enabling spinners to obtain a much wider choice than formerly."

378. COTTON GROWING IN THE EMPIRE. (*Times Trade and Eng. Supplmt.*, May, 1936.) A useful general account of the satisfactory progress made in cotton production in the new fields of the Empire, discussing the numerous difficulties encountered and the valuable help rendered by science in overcoming them. The 1934-35 crops of the Sudan, Uganda, Nigeria, Tanganyika, Nyasaland, and Queensland are analysed. In regard to the Indian crop, nearly 75 per cent. of which consists of short-staple cotton, successful efforts are being made to improve the staple in areas where the growing season is suitable, or can be lengthened by means of irrigation.

379. ASIA. CEYLON: *Progress in the Development of Crops in the Hambantota District.* By G. Harbord. (*Trop. Agr.*, lxxxvi., 2, 1936, p. 102.) Much work has been done to induce more widespread cultivation. For the 1935-36 season cotton seed to a total of 3 tons 7 cwt. has been issued for sowing. There is a decided increase in the area under crop this year, estimated at 750 acres, and so far the prospects are good.

380. CYPRUS: *Cotton Experiments, 1935.* (*Cyprus Agr. J.*, xxxi., 1, 1936, p. 20.) The cotton experiments started in 1930 were repeated in 1935 at the Central Experimental Farm, Morphou. It is hoped by the experiments to find suitable varieties of cotton and to improve cultural operations as a step towards the general improvement of the Cyprus cotton industry. The experiments comprised: time of sowing, fertilizer, spacing, irrigation, and varietal trials. The strains tested were Mesowhite, U.4, Giza II., III., and VII., Sakelariadis, Sakha II. and IV., Nahda, and Cyprus Select. Mesowhite again gave the highest yield, but the Egyptian varieties were superior in ginning outturn.

381. AFRICA. TENURE OF NATIVE LAND IN EAST AFRICA: THE ECONOMIC ASPECT. By V. Liversage. (*E. Afr. Agr. Jour.*, i., 5, 1936, p. 372.) Discusses I. Public Ownership: Communal Tenure, Feudal Tenure, Cultivating Tenure; II. Private Ownership: Share Tenancy, Cash Tenancy, Owner Occupation.

382. NIGERIA. *The Introduction of Mixed Farming in Northern Nigeria.* By O. T. Faulkner and J. R. Mackie. (*Empire J. of Exp. Agr.*, iv., 13, 1936, p. 89.)

During the last year or two the introduction in Northern Nigeria of a system of mixed farming *cum* animal husbandry has made remarkable progress.

Previous to the introduction of the system to the natives some six years were spent by the Agricultural Department in experimental work and in testing every detail, and as a result better agricultural implements were devised, the local cattle were improved by selective breeding and were immune from rinderpest, and the best method of making and utilizing manure was ascertained.

The system was demonstrated to the native agriculturists on demonstration farms as closely resembling their own farms as possible, and the number of farmers who wish to adopt the system of mixed farming is increasing every year. To help the farmers in the purchase of the cattle and implements small loans are granted by the Native Administrations, which are repayable in three or four years. Many problems still remain to be solved, but the progress made up to the present is most encouraging.

383. NYASALAND: *Cotton Prospects*, 1935-36. A report recently received from H. M. Eastern African Dependencies Trade and Information Office states that cotton is looking very well at all elevations below 2,500 feet. There is little aphid and jassid, but there is a higher percentage of perforated buds and bolls than usual. The proportion of cotton planted in maize gardens shows an increase over last year.

384. SOUTHERN RHODESIA: *Cotton Cultivation*, 1934-35. (*Rpt. of Secy. Dpt. of Agr. and Lands*, 1935.) The constant rains in the early part of the season retarded growth, and rains ceased at a critical period. The yield was further reduced by the earliness and severity of the winter. It is proposed during 1936 to encourage natives to grow cotton in areas capable of giving reasonable returns; at existing prices there seems no other crop which can be grown by natives which can better bear the cost of transport and overseas marketing.

Mr. G. S. Cameron, the Corporation's Cotton Specialist, reports that many crops were badly affected by American bollworm. Sudan bollworm was not much in evidence, but investigations at Gatooma indicate that this pest may become serious if the evil practice of ratooning cotton is allowed to become general. Stainer damage was less than usual, owing probably to the early termination of the rains. Little injury was caused by jassid.

In the breeding work carried out at Gatooma the best results were again obtained with U.4/64 derivatives. Investigations carried out by the insect pest control section have resulted in much useful data being collected in regard to egg-laying of American bollworm on crops other than cotton, and concerning the stainer problem of the Sabi Valley.

385. SUDAN: *Cotton Cultivation*, 1935-36. (*Int. Cott. Bull.*, xiv., 54, 1936, p. 151.) The prospects of the crop are stated to be good. Floods and rains in the different districts have been generally smaller and lighter than last season, and even below normal in the Tokar and Gash areas. In Kordofan, the rains, though very much lighter than last year, are reported as sufficient; according to seed issues a larger crop is expected.

386. THE DEVELOPMENT OF NATIVE AGRICULTURE IN THE NUBA MOUNTAINS AREA OF KORDOFAN PROVINCE, ANGLO-EGYPTIAN SUDAN. By G. F. March, (*Empire J. of Exp. Agr.*, iv., 13, 1936, p. 77.) An interesting description of the introduction of cotton into the area, for which the author was largely responsible, and which resulted in the output of 25,000 bales within eleven years. This was the first step—to introduce a paying crop, and now rotation of crops and the use of animal-drawn implements are being introduced.

387. TANGANYIKA: Cotton Uprooting and Burning. By W. V. Harris. (*Ent. Leaflet No. 13, 1936.*) An explanation of the objects in view in the Government programme of uprooting and burning of cotton plants, and the establishment of a close season.

388. EAST AFRICAN AGRICULTURAL RESEARCH STATION, AMANI, TANGANYIKA TERRITORY. (*Seventh Ann. Rpt., 1934-35.*) Contains the usual reports of the Director, Plant Pathologist, Entomologist, Soil Chemist, Biochemist, Plant Physiologist, Geneticist, Systematic Botanist, Superintendent of Plantations, Secretary and Librarian. In March, 1934, the position of the Amani Library as the central scientific reference library for East Africa received recognition in the most practical and munificent manner by the grant of £10,000 from the Carnegie Corporation as a permanent endowment. The long-awaited Tanganyika sisal station came into being in 1935. A new building to accommodate members of the staff and a new guest house were built during the year.

389. UGANDA: Cotton Experiments. (*Bull. Imp. Inst., xxxiii., 4, 1935, p. 491.*) A brief description of various experiments conducted at Bukalasa during the period January-June, 1935. In connection with breeding work the B.P. 50 (ex-Buganda Local) group has gained some uniformity in staple, but is still susceptible to blackarm disease. The S.G. 23/8 (ex-Nyasaland Upland) group has not so far produced a satisfactory combination of long staple and high ginning outturn, but is less susceptible to blackarm. Another pedigree strain, B.P. 89 (ex-Buganda Local), gives a high yield in spite of susceptibility to blackarm, and has good lint characters. The U 4/4/2 group (ex-Barberton via Serere) yielded very well, but has unsatisfactory staple character. Other experiments carried out included spacing trials, topping, interplanting, mulching, and manurial experiments. Mulching with elephant grass to a depth of 3 inches (as opposed to 6 inches in the previous year) still increased the yield of cotton, and the net return after deducting the cost of mulching is now greater than from the control plots. Green manure gave the best results when dug in 4 to 6 weeks before the planting of the cotton. Interplanting with beans or groundnut increased the yield of cotton.

390. Cotton Reports, 1934-35. (*Ann. Rpt. of Dpt. of Agr., 1934, Pt. II., received 1936.*) From the report of the Botanical Section we learn that weather conditions throughout the country were dry and generally abnormal, the result being a reduction in yield of cotton per acre. Blackarm developed to a greater extent than hitherto at Bukalasa, but the plants recovered later. The cotton breeding results were more encouraging than for several years. The U. 4/4/2 derivative—S.P. 87—selected at Serere, gave lint superior to S.G. 29, and promise of a better yield. The strain will be increased as rapidly as possible for general distribution should broker's and spinning reports prove satisfactory. At Bukalasa successful results were obtained with a new strain B.P. 50, which proved superior in yield, ginning outturn, length, strength, and uniformity to Local cotton. The S.G. 23/8 variety maintained its high spinning performance and uniformity. Both B.P. 50 and S.G. 23/8 were highly resistant to blackarm.

Investigations carried out by the Entomological Section to determine the damage, if any, caused to cotton in Uganda by jassid, showed that jassid infestation was almost negligible. Work on pink bollworm, stainers, and *Lygus* was continued. In the south and south-west districts considerable damage was caused to crops by the red locust.

The Mycological Section reports that blackarm and angular leafspot were more in evidence; wilt disease also was increasing, and attempts were being made to isolate resistant strains of cotton. Other cotton diseases occurring during the season were *Alternaria* and *Cercospora* leafspots, and *Ramularia areola*, which was conspicuous on U.4 derivatives.

391. Cotton Industry, 1935-36. (*Crown Colonist*, March, 1936, p. 138.) A spell of fine weather has ripened the crop and counteracted damage done by unseasonal rains. The buying season has opened in the Eastern Province, and cotton is plentiful, with free arrivals. The price offered is Sh. 10 to Sh. 11 per 100 lb. of raw cotton, and growers are keen to sell. Cotton seed at Sh. 35 per ton f.o.r. Kilindini is being bought, and 30,000 tons have already been purchased. £100,000 was collected in cotton tax in 1935.

392. SOME EFFECTS OF THE DEVELOPMENT OF THE COTTON INDUSTRY ON NATIVE AGRICULTURE IN UGANDA. By C. G. Hansford. (*Empire J. of Exp. Agr.*, iv., 13, 1936, p. 81.) An interesting discussion of the effects of cotton in the native agriculture, which tends to show, *e.g.*, in a deterioration of the soil, which was formerly more carefully conserved. The main problem in the further development of cotton production and of native food production in Uganda is to increase yields rather than to extend the cultivated area. Such increase can be obtained partly by producing improved varieties of cotton and of native food-crops, and partly by introducing improved methods of agriculture, notably mixed farming.

393. AUSTRALASIA. QUEENSLAND: Cotton Prospects, 1935-36. (*Queensland Agr. J.*, January, 1936, p. 78.) During the early part of January dry conditions prevailed throughout the cotton belt, but useful rains were recorded later over most areas, with the exception of the Callide, where the rainfalls generally were less than 1 inch. Owing to the dry conditions prevailing after germination an excellent deep rooting system was established, which should enable the plants to withstand to a much greater extent any future hot dry spells. Insect pests other than those attacking cotton in the seedling stage were not severe.

394. QUEENSLAND COTTON BOARD. (*Queensland Agr. J.*, January, 1936, p. 92.) An Order in Council has been issued under the Primary Producers' Organization and Marketing Acts amending the Order in Council constituting the Cotton Board. The amendment provides that, in connection with the elections of the Cotton Board, a person growing cotton in more than one district can only exercise one vote, and that for the district in which he has the greatest area of cotton.

395. WEST INDIES. THE WEST INDIAN COTTON INDUSTRY. By C. C. Skeete. (*W. India Comm. Circ.*, li., 979, 1936, p. 143.) A brief account of the industry in 1934-35 with figures of production for the various islands, and estimates for the 1935-36 season.

396. ST. VINCENT: Cotton Cultivation, 1934-35. (*Rpt. on Agr. Dpt.*, 1934, recently received.) The area under Sea Island cotton was 1464 acres and under Marie Galante 652 acres. Weather conditions were favourable to the germination of the seed and subsequent growth of the plants. There was some wilting of young seedlings, and aphid attacks were common. Other pests causing injury to cotton were stainers, pink bollworm, and mole crickets, and these are being combated with considerable success by rigid close season, destruction of alternate host plants, and breeding of resistant cotton varieties.

At the Cotton Experiment Station the regular reproduction of good seed was carried on, to maintain the purity of the island's supply. The production of Red Sea Island strains was continued, and they were found to be more robust and more resistant to angular leafspot and aphid than V. 135, less prone to damage by high wind, and to have rather better lint qualities, but to mature about a week later, and to have fewer seeds.

The experiment to combine the lint strength and quality of V. 135 with the high lint yield per acre of Montserrat Sea Island progresses satisfactorily. Work with perennial cottons is being continued with a view to producing strains of Moco cotton superior to the Carriacou cotton C. 1.

397. *Cotton Prospects, 1935-36.* A note on the cotton crop for the quarter ended December 31 last, received from the Superintendent of Agriculture, is to the effect that weather conditions were satisfactory for the growth of the crop, and yield was expected to be better than the average. The use of sulphate of ammonia resulted in larger and more uniform plants. Showery weather in December caused some loss of bolls from external boll disease, and about 10 per cent. of the early pickings were stained. Pink bollworm, though more in evidence, caused little damage, but considerable losses from stainers were feared on some estates.

398. *Alteration of Date of Expiry of "Close Season."* (*Int. Cott. Bull.*, xiv., **54**, 1936, p. 142.) Owing to a petition of certain planters to be allowed to plant on August 1, the date of expiry of the close season has been changed from August 31 to August 15. In certain districts the supply of labour is not adequate to plant the desired area in September, and sowing in October has been found to give poor results. It is feared, however, that too great an advance in the sowing date may lead to an increase in boll diseases, and may necessitate picking in wet weather.

399. *New Cotton Machinery.* (*W. Ind. Comm. Circ.*, li., **980**, 1936, p. 177.) A new cotton ginnery has been opened by the Agricultural Credit and Loan Bank. Seed cotton is purchased on a co-operative basis. An advance is paid, depending on the market price—this year it is 6 c. per lb. for white and 1½ c. for stained—and at the end of the trading period a bonus is declared, after all expenses plus a commission have been deducted from the gross receipts. A single electrically driven gin and a manual baling press are being used. The total number of ginneries in operation in St. Vincent and its dependencies is now five. A new baling press and an electrically driven hydraulic pump have been ordered by the Government ginnery.

COTTON IN EGYPT.

400. THE EGYPTIAN COTTON CROP. By J. A. Todd. (*Gt. Britain and the East*, 26/12/35 and 2/1/36.) Supplies, prices, consumption and markets are discussed, and the author sums up the whole position as follows: "It appears that while during the last four seasons the price of Egyptian cotton has been dragged out of its normal course by the abnormal position of American cotton (due to Government control), the statistical position of Egyptian is now so strong that it ought to assert itself in rising prices, especially as the American position is now tending definitely in the same direction."

401. SELLING EGYPTIAN COTTON "ON CALL." (*Int. Cott. Bull.*, xiv., **54**, 1936.) p. 182.) A discussion of the arguments for and against the practice.

402. "THE EGYPTIAN COTTON YEAR-BOOK, 1934-35." We have received from the Editor a copy of this publication. It contains a review of the 1934-35 cotton season and prospects for 1935-36, and numerous tables of cotton statistics. In addition there are the following short articles: "Cotton Research Work at Giza" (C. H. Brown); "Cotton v. Rayon Staple Fibre" (Anon.); "The Egyptian Cotton Section of the Lancashire Cotton Industry" (D. Windel); "The Egyptian Cotton Market in America during 1934-35" (W. K. Shaw); "The Egyptian Section of the Cotton Industry on the Continent of Europe" (G. J. Pettenpaul); "The Propagation of Egyptian Cotton Seed" (C. H. Brown).

403. A NEW VARIETY OF EGYPTIAN COTTON. (*Int. Cott. Bull.*, xiv., **55**, 1936, p. 313.) A new cotton which may replace Sakel has been originated by the Royal Agricultural Society, and will in the near future be cultivated in Egypt. One

of its most striking characteristics is the whiteness of the fibre, which can rival even that of Tanguis, a cotton noted for this quality. The cotton has not yet received a name. The staple length is 37 mm., and the resistance is equal to that of Giza 7. The plant is small in size, and matures from 10 to 15 days earlier than other varieties, which will enable it to withstand the attacks of pink bollworm. The yield is very satisfactory, and the results of spinning tests have also proved satisfactory. The propagation of the cotton has already commenced at the Nachaat Experimental Farm in Lower Egypt, where it is intended to plant 50 feddans this year. The future prospects of the new variety would appear to be bright.

404. EXPERIMENTS IN EGYPT ON THE INTERRELATION OF FACTORS IN CROP GROWTH. I. A PRELIMINARY INVESTIGATION OF THE INTERRELATION OF VARIETY, SPACING, NITROGEN, AND WATER SUPPLY, WITH REFERENCE TO YIELDS OF COTTON. By F. Crowther and A. Mahmoud. (*Bull. No. 22 of Tech. Sect. Roy. Agr. Soc., Egypt, and Bull. No 1 of Roy. Agr. Soc. and Imp. Chem. Indus., Ltd., Joint Agr. Res. Scheme, 1935.*) Describes the results of two large-scale field experiments carried out on cotton in Egypt in 1934. One experiment was situated at Bahtim, near Cairo, and the other at Gemmeiza, in the middle of the Delta. Both included comparisons of four factors: variety, spacing, nitrogen manuring, and watering. The results indicated that the heavier yielding varieties were more responsive to application of manures, that medium spacing (20 cms. between holes; ridges 65 cms. apart) gave the highest yields, and that increase of water at each irrigation had no significant effect on yield.

COTTON IN THE UNITED STATES.

405. THE WORLD COTTON SITUATION: COTTON PRODUCTION IN THE UNITED STATES. (*U.S. Dpt. of Agr., Bur. of Agri. Econ., Washington, D.C., 1936.*) This constitutes the second part of a special study of the world cotton situation undertaken by the Bureau of Agricultural Economics, U.S. Dept. of Agriculture, and is concerned with cotton production in the United States. The present section is an analysis of the forces that have affected cotton production in that country, particularly during the past three decades, and of the principal factors that should be considered in the formation of a domestic policy that would be of most benefit to American cotton growers. Sections dealing with other aspects of the subject will be issued as prepared. (Cf. Abstr. 537, Vol. XII. of this Review.)

406. THE DEVELOPMENT OF THE COTTON TEXTILE INDUSTRY OF THE UNITED STATES FROM 1920 TO 1930. By G. Osborne. (*J. Text. Inst., xxvii., 1, p. 4; 2, p. 30, 1936.*) A study undertaken as part of the general problem of determining the nature of the technical and economic forces that led to the migration of the cotton textile industry from the New England States to the South. Tables of statistics show growth and decline of the industry, the gradual move to the South, etc.

407. ECONOMIC DEVELOPMENT OF THE COTTON TEXTILE INDUSTRY IN THE UNITED STATES, 1910-35. Compiled by E. L. Day and R. P. Lane. (*U.S. Dpt. Agr., Bur. Agr. Econ., Agr. Econ. Bibliog., 57, 1935. From Exp. Sta. Rec., 74, 3, 1936, p. 408.*) This selected bibliography "lists books and periodical articles descriptive of the general development of the cotton textile industry in the United States, and of specific conditions which affected its development during the period 1910-35. . . . The references are arranged chronologically by date of publication and alphabetically by author (or title when anonymous) under

the year." References to sources of statistics are included in a supplementary section, and an author and subject index is appended.

408. AMERICAN COTTON MARKETING RULES. By B. J. Kane. (*Cotton*, U.S., 99, 12, 1935, p. 48. From *Summ. of Curr. Lit.*, xvi., 4, 1936, p. 85.) An interpretative commentary is provided on the 1935 Southern Mill Rules applying to the sale, purchase, transportation and handling of cotton, recently adopted by the American Cotton Manufacturers' Association and the American Cotton Shippers' Association to replace the 1925 Southern Mill Rules.

409. FLORIDA: Cotton Varieties. By W. A. Carver. (*Flor. Sta. Bull.* 285, 1935. From *Exp. Sta. Rec.*, 74, 2, 1936, p. 190.) Results of variety trials are given, indicating that Cleve wilt and Rhyno Cook are the most profitable strains and combine several good characters.

410. WILT-RESISTANT COTTONS ADAPTED TO THE GULF COASTAL PLAINS. By D. C. Neal. (Abstr. in *Phytopathology*, xxv., 10, 1935, p. 974. From *Rev. App. Mycol.*, xv., 3, 1935, p. 149.) The most suitable varieties were selections of Dixie Triumph, Miller, and D. and P. L., which have given yields exceeding one bale per acre under conditions of severe infestation. The fibre of several of the selections is also of superior quality and correct length.

411. SOUTH CAROLINA: Field Crops Experiments, 1934-35. (*S. Car. Exp. Sta. Rpt.*, 1935.) The research work on cotton included the following: varietal tests; breeding, time of sowing, and spacing experiments; studies of the rate and time of application of fertilizers; tests of various brands of sodium nitrate; a comparison of the effects on cotton production of winter cover crops of rye and Austrian peas in combination with sodium nitrate; the effects of additions of dolomitic limestone and calcium sulphate on cotton yields.

COTTON IN FOREIGN COUNTRIES.

412. COTTON CULTIVATION IN SOUTH AMERICA. (*M/c. Guar. Coml.*, 31, 1935, p. 458. From *J. Text. Inst.*, xxvii., 2, 1936, A44.) The most striking progress has been made in Brazil, where production has increased from 450,000 to 1,600,000 bales of 478 lb. since 1932. The country now ranks sixth among cotton-producing countries. Production in Peru has increased from 250,000 to 300,000 bales during the last three years. Argentine is encouraging farmers, especially those in the Chaco territory, to increase their cotton acreage. Cotton cultivation is also being encouraged in Chile, Paraguay, Colombia, and Bolivia.

413. ARGENTINA: Cotton Cultivation. (*M/c. Guar. Coml.*, 31, 1935, p. 458. From *J. Text. Inst.*, xxvii., 2, 1936, A44.) The Argentine cotton-growing industry is making impressive progress, the estimated area for the 1934-35 season amounting to 279,000 hectares. A rapid development in the Chaco territory is expected. The Government is assisting the cotton-growing industry by means of subsidies, seed grading, the appointment of an English expert to advise growers, and the formation of the National Cotton Commission. The Commission recommends the cultivation, according to zone, of Carolina Foster, Lightning Express, Acala and Durango long-staple cottons. It undertakes to purchase the product at a price based on the market quotations. The Bank of the Argentine Nation is prepared to make loans to cotton planters at a rate of 6 per cent. per annum.

414. Cotton Cultivation. (*Text. Rec.*, liii., 636, 1936, p. 65.) The first group of thirty American cotton-growing families left the United States in February under the Argentine Government scheme to develop cotton-growing in the Chaco. Each family must pay its own passage out and possess about \$600

in cash. According to the Argentine Consul at New Orleans, his office has been "flooded with applications" since the terms of the invitation were made known. This flight from cotton in the States in order to establish cotton in the Argentine Republic may, in the not-too-distant future, have far-reaching consequences to the North American industry; the readiness to leave shown by whole groups of families—and families by no means destitute—is certainly eloquent evidence of the present chaotic state of the industry.

415. BRAZIL: Cotton Cultivation. We have received from Rio de Janeiro a copy of *Algodão* for November last, dealing chiefly with cotton cultivation in the State of Piahy in N.E. Brazil. The main varieties of cotton grown are Verdao, Quebradinho, Moco, and Express. In 1933-34 production was 2,200,000 kilos; in 1935-36 it is estimated that production will reach 10,000,000 kilos. The country is stated to possess excellent conditions for cotton cultivation.

416. SOME NOTES ON COTTON IN COLOMBIA. By S. C. Harland. (*Trop. Agriculture*, xiii., 2, 1936, p. 31.) Cotton is grown in Columbia as an adjunct to food crops, and its needs must necessarily remain agriculturally subordinate to such crops. The cottons cultivated are a variety of Bourbon *G. purpurascens* Poir (in the Atlantic region) and *G. barbadense*. The former has a ginning percentage of 30 to 32 with a lint length of $\frac{1}{2}$ to $1\frac{1}{2}$ ins., and the latter a ginning percentage of 40 or even higher, and a lint length of 1 in. Insect pests, especially cotton stainers and Trinidad bollworm, constitute a serious menace, and are a bar to any large-scale development of cotton in the country.

417. ASSOCIATION COTONNIÈRE COLONIALE. *Bull. No. 22, 1936*, contains the following papers: "Note sur la culture du coton dans les Etats du Levant sous mandat français" (Schuler); "L'activité du comité cotonnier de l'Afrique Equatoriale Française" (du Vivier de Streel); "Faut-il cultiver le coton en Algérie" (Munck et Saunier); "Le Conseil de Gouvernement de l'Afrique Occidentale Française de 1935" (Brevié); "La mise en valeur de l'Empire" (G. Chenard).

The usual notes on cotton in the French Colonies and other cotton-growing countries, cotton legislation, marketing, etc., are included.

418. MOROCCO AS A COTTON COUNTRY. By E. Miegé. (*Man. Guar. Coml.*, 7/2/36.) A brief review of the past history and the possibilities of cotton cultivation in Morocco under French influence. The most suitable cotton is a variety of Pima, No. 67, with a yield of 1,200 kg. per hectare, and a ginning outturn of 32 to 34 per cent. Cotton cultivation is capable of great expansion in the country.

419. GERMAN TEXTILE INDUSTRY: PRODUCTION COSTS. By E. Eigenbertz. (*Spinn. u. Web.*, liii., Nos. 48-49, 1935. From *J. Text. Inst.*, xxvii., 2, 1936, A90.) The author discusses the effect of output on costs of production, and traces the influence of the introduction of machinery, recent rationalization schemes, modern automatic and high-speed machinery, changes in raw material costs, wage rates, rents and taxes, and developments in social services on total costs of production and on the ratio of fixed to other costs in the German textile industry.

420. IRAQ: Cotton Cultivation. (*Int. Cott. Bull.*, xi., 54, 1936, p. 146.) The cultivation and export of cotton was originally encouraged by the British Cotton Growing Association, who established a ginnery in Bagdad in 1922. Progress, however, was slow, and not until 1928 did the crop exceed 5,000 bales. Poor seasons and falling prices then adversely affected the cultivation of cotton, but in 1934 a partial recovery was made, and 2,000 bales were exported. The 1935

crop is expected to exceed the previous record of 5,000 bales. The original ginnery has passed from the ownership of the British Cotton Growing Association into the hands of the former manager, and a second ginnery run by an Iraq company has been established.

421. JAPAN'S COTTON EXPORTS. (*Text. Rec.*, liii., 636, 1936, p. 13.) According to a recent analysis, exports of cotton piecegoods from Japan during 1935 amounted to 2,728,000,000 sq. yards, against 2,578,000,000 sq. yards in 1934, which represents an increase of 5.9 per cent. This compares with increases of 23 per cent., 6 per cent., and 43 per cent. respectively in the years 1934, 1933, and 1932, as compared with preceding years, and is regarded as a serious setback in Japanese trade circles. Although the total exports increased in 1935, there were sharp decreases in many countries, and it would seem that Manchukuo, China, and the Near East are the only directions in which further expansion can be expected.

422. COTTON CULTIVATION AND DELIVERIES IN U.S.S.R. (*Int. Cott. Bull.*, xiv., 54, 1936, p. 152.) By October, 1935, the quantity of cotton delivered by the State purchasing organizations was 920,000 tons compared with 352,000 tons by the same date in 1934. The Government's decision of December, 1934, to increase the price paid by the State purchasing organizations more than threefold was of great help towards a successful fulfilment of the delivery plans. Another factor which tended to the same end was the increase in monetary advances made to the cotton growers by the Government.

423. RUSSIA: Spring Sowing Plans. By L. Segal. (*Man. Guar. Coml.*, 24/4/36, p. 377.) A review is given of Soviet agriculture. In 1936 an area of 96,332,700 hectares is to be planted to spring crops; this is an increase of nearly three million hectares over the previous year. The area to be planted to cotton is 2,015,000 hectares.

424. THE AZERBAIDZHAN REPUBLIC, U.S.S.R. (*Monthly Rev. of U.S.S.R.*, February, 1936.) Describes the improvement in conditions under the Soviet Government. The country has now assumed second place for cotton in the U.S.S.R., and Egyptian cotton cultivation is increasing. Important irrigation works have been carried out during the last few years in the Mugan, Shirvan, and Mill steppes.

425. TURKEY: Cotton Cultivation. (*Cotton M/c.*, 2/5/36.) The prospects of the 1936 crop are at present excellent. A considerable proportion of the crop is exported to Germany and Japan, the balance being consumed in the country. As a result of high prices obtained for their cotton, cultivators are more prosperous than they have been for many years. Attempts are being made under the auspices of the Ministry of Agriculture to increase the cultivation of cotton.

SOILS AND MANURES.

426. IMPERIAL BUREAU OF SOIL SCIENCE. (*Report for year ended March 31, 1936.*) A year of satisfactory progress is recorded. The most ambitious publication of the Bureau—*The Bibliography of Soil Science*—issued in August, 1935, was well received, and it is hoped that other bibliographies will follow at suitable intervals. Two technical publications: *Tea Soils* (H. H. Mann) and *Organic Manures* (S. H. Jenkins), were issued during the year.

427. A PROVISIONAL SOIL MAP OF EAST AFRICA (KENYA, UGANDA, TANGANYIKA, AND ZANZIBAR) WITH EXPLANATORY MEMOIR. By G. Milne. (Obtainable from the East African Agr. Res. Station, Amani, Tanganyika Territory, or the Crown Agents for the Colonies, 4 Millbank, London, S.W.1. Price 5s. post free.) A

useful map, with an interesting general account of the kinds of soil met with over East Africa, which should be read by those concerned with agriculture there.

428. SOIL PROFILE IN RELATION TO YIELD. By B. W. Whitfield. (*Trans. Third Int. Cong. of Soil Sci.*, vol. i., 1935.) The results of experiments carried out at a Pump Scheme at Dueim on the White Nile—where the remarkably high yield of seed cotton was obtained of over 2,000 lb. per acre—showed that there are three definite types of soil profile in this area. The yield is related to soil profile and salt content. Soil profile type appears to exert a greater influence on yield than salt content; this may be due to the greater buffering action of the heavier soils. Although the White Nile contains no sulphates this soil, which is a river alluvium, contains appreciable amounts of gypsum, probably derived from the run-off from the west.

429. SOIL NITROGEN. By B. W. Whitfield and A. J. Henry. (*Trans. Third Int. Cong. of Soil Sci.*, vol. i., 1935.) The following is a summary of some of the results obtained to date from an investigation started in 1932 in the Gezira to find out how the nitrogen was distributed in the soil, and in particular what happened to such nitrogenous fertilisers as ammonium sulphate when added to the soil under various conditions of temperature and humidity:

On treating the natural soil with the optimum amount of water the nitrite nitrogen rises immediately to a maximum and then falls rapidly to the normal low figure. This is accompanied by a slight rise in albuminoid nitrogen and a much slower return to normal. A little before the point of maximum nitrite the nitrate begins to increase while the free ammonia undergoes a corresponding decrease. The same series of changes is observed when ammonium sulphate is added to the soil. Disappearance of free ammonia is very rapid when it starts. When gluten is added to the soil the changes are more complicated. The nitrogen of gluten is partly albuminoid and partly residual. The nitrite change takes place as usual. At the same time the gluten nitrogen is rapidly converted into free ammonia and the completion of this change is followed by about three weeks' delay before formation of nitrate commences.

Rise of temperature (up to 40° C.) favours the formation of nitrite, the maximum concentrations being greater and reached sooner as the temperature rises. Also disappearance of free ammonia commences progressively earlier as the temperature rises. There is a tendency for nitrate to be converted into residual nitrogen. At temperatures below 25° C. this change is slight, but is greatly accelerated as the temperature increases above this figure.

Waterlogging the soil suppresses almost completely the whole process of nitrification. It favours, however, the conversion of nitrate into residual nitrogen, as does also the addition of non-nitrogenous organic matter to the soil.

430. SOIL NITRATES IN THE SUDAN. By H. Greene. (*Trans. Third Int. Cong. of Soil Sci.*, vol. i., 1935.) The nitrate content of land under cotton shows no relation to final cotton yield. Some indications have, however, been obtained that the period of activity initiated by the rains is of importance to the cotton crop in the sense that the optimum date for sowing cotton depends not so much on the calendar as on the action of early rains on soil organisms and soil nitrogen.

431. THE NITRATE PROFILE IN AN ARID SOIL. By O. W. Snow and H. Greene. (*Trans. Third Int. Cong. of Soil Sci.*, vol. i., 1935.) The results of investigations on the relationship between nitrates and the soil profile in the Sudan Gezira are discussed.

432. AVAILABILITY OF NITROUS NITROGEN TO PLANTS. By G. S. Fraps and A. J. Sterges. (*Bull. No. 515, Texas Agr. Exp. Sta.*, 1935.) The availability of nitrites was studied by means of pot tests with soils and by experiments in water

cultures, for the reason that previous work has shown the possibility of the occurrence of appreciable amounts of nitrites in some soils. Large amounts of nitrites were injurious to plants in the pot tests. Small amounts of nitrites seem to be taken up from the soil and utilized as well as the same amounts of nitrates. With somewhat larger amounts of nitrites, the amount taken up was about 76 per cent. of that by nitrates. Since nitrites added to sterilized sand were partly changed to nitrates, it was possible that there was some transformation of nitrites to nitrates during the period of growth of the plants in the soils. In water cultures the relative growth of plants produced by nitrates and nitrites varied with the acidity or alkalinity of the solution. Corn made the greatest growth with the nitrates at a pH of 3.9-4.1, and the lowest growth at 6.4-7.7, while with the nitrites the growth was in the reverse order, being lowest at pH 3.9-4.1 and highest at 6.4-7.7. Similar results were secured with cotton and oats. If the growth of the plants in the water cultures is taken as a measure of availability, the availability of the nitrites at pH 6 was approximately 21 per cent. of that of nitrates. At a pH of 3.9-5.4 the average availability of nitrites was 4 per cent., while at pH 6.4-7.7 it was approximately 112 per cent. of that of nitrates. Nitrites are more likely to occur in alkaline soils than in acid soils. They are more readily taken up by plants in such alkaline soils.

433. SOIL WATER RATIOS IN BASE EXCHANGE. By H. Greene. (*Trans. Third Int. Cong. Soil Sci.*, vol. i., 1935.) Discusses (1) Vageler's formulation of base exchange, and (2) the effect of change in soil-water ratio.

434. SOILS AND FERTILIZERS. By E. M. Crowther. (Reprinted from *Rpts. of the Progress of App. Chem.*, xx., 1935.) A useful review of the work of the year in connection with soil science, including that of the Third International Congress of Soil Science. The subject is dealt with under the following headings: Soil Surveys and Classification; Soil Formation; the Crystal Structure of Clays; the Inorganic Soil Colloids; the Physical Properties of Soils; the Determination of Exchangeable Bases; the Estimation of Nutrient Contents; the Availability of Phosphates in Soils and Fertilizers; Fertilizer Application and Root Distribution; the Minor Elements in Plant Nutrition; the Production and Use of Fertilizers; Weed Killers; the Design of Experiments; Analysis of Soils, Fertilizers and Crops; Miscellaneous.

435. EFFECTS OF CERTAIN SOIL TYPES, SEASONAL CONDITIONS, AND FERTILIZER TREATMENTS ON LENGTH AND STRENGTH OF COTTON FIBRE. By O. A. Pope. (*Arkansas Sta. Bull.* 319, 1935. From *Exp. Sta. Rec.*, 73, 6, 1935, p. 775.) A determination of certain measures of dispersion for a number of fibre and seed properties in cotton, and an investigation of the effect of soil types, seasonal conditions, and fertilizer treatments on these properties are reported. The studies included a uniformity test composed of 5 varieties replicated 10 times at each of 3 locations, and a variety-location-season test consisting of 4 varieties at 4 locations in three years. In the fertilizer test, which did not produce satisfactory results due to soil irregularity, 4-10-4 fertilizer was applied in increment steps of 200 lb. from 0 to 1,600 lb. per acre, including 2 locations in two years. The 16 variables considered were weights of seed plus lint, of seed, and of lint, and percentage lint, all for gin data; mean length over $\frac{1}{2}$ inch, maximum length, modal length on a weight basis, primary mode on an estimated number basis, and secondary mode on a number basis, all concerned with length measures; percentage by weight $\frac{1}{2}$ inch and less, and percentage weight in the modal group, which measure relative weight of fibres in different parts of the distribution; percentage number of fibres in the primary and in the secondary modal groups, and of fibres $\frac{1}{2}$ inch and less, which measure relative number of fibres in various parts of the distribution; coefficient of variability; and tensile strength.

436. EFFECT OF FERTILIZERS ON THE LENGTH OF COTTON FIBRE. By E. B. Reynolds and R. H. Stansel. (*J. Amer. Soc. Agron.*, 27, 5, 1935, p. 408. From *Exp. Sta. Rec.*, 73, 6, 1935, p. 777.) Since application of phosphoric acid to cotton at the Troup Substation, Texas, on Kirvin fine sandy loam apparently increased the length of fibre, a further fertilizer test was made in 1933 at the Angleton Substation on Lake Charles clay soil, which is low in phosphoric acid. While some significant differences in fibre length were obtained from the variously treated plats, they apparently were not caused by differences in the amounts of nitrogen, phosphoric acid, or potash, or by different rates of application.

437. COTTON CROP: EFFECT OF PHOSPHORIC FERTILIZERS ON YIELD. By A. Mahmoud. (*Bull. No. 21, Roy. Agr. Soc., Egypt, 1934. From J. Text. Inst.*, xxvii., 2, 1936, A45.) Superphosphates, both ordinary and concentrated, and basic slag, when used with ammonium sulphate, increased cotton yields, but with the other phosphatic fertilisers somewhat reduced yields were given. Superphosphate shows some indication of hastening maturation.

438. ORGANIC MANURE: SOME FURTHER NOTES ON COMPOST. By S. D. Timson. (*Rhod. Agr. J.*, xxxiii., 3, 1936, p. 175.) Replies to questions that are sometimes raised by people wishing to try the Indore process, such as "Do not white ants render it impracticable?" "Why must all green material be withered?" "How much rainfall is needed?" and the like. It is shown that errors in manufacture mainly increase the time required, though the result is about the same; but for economical working accuracy is necessary.

439. COMMERCIAL FERTILIZERS IN 1934-35. By G. S. Fraps and S. E. Asbury. (*Bull. No. 517, Texas Agr. Exp. Station, 1935.*) Contains statistics regarding fertilizers sold in Texas, information regarding the fertilizer law, and analysis of samples of the fertilizer sold by different manufacturers. Tables are given showing the extent to which the various fertilizer manufacturers met or exceeded their guarantees. Sales of fertilizer increased about 25 per cent. over last year, but the cost was slightly more.

440. EFFICIENCY OF AMMONIATED SUPERPHOSPHATES FOR COTTON. By J. T. Williamson. (*J. Amer. Soc. Agron.*, 27, 9, 1935, p. 724. From *Exp. Sta. Rec.*, 74, 1, 1936, p. 30.) In 185 fertilizer experiments with cotton, made on different soil groups by the Alabama Experiment Station, average yield increases due to phosphorus were greatest on the Highland Rim and Appalachian Plateau soil groups, and least on the Greenville soil group of the Coastal Plain. Relative increases due to different phosphorus carriers on all except the Greenville group agreed with the relative increases in the average of all experiments which, with the increases due to superphosphate as a basis, were for superphosphate, 100; ammoniated superphosphate (2 per cent. N.), 100; ammoniated superphosphate (4 per cent. N.), 90; and precipitated tricalcium phosphate, 85. Ground limestone used with complete fertilizer containing superphosphate and 4 per cent. ammoniated superphosphate, respectively, produced average increases of 53 and 16 lb. of seed cotton per acre.

441. SOIL EROSION. TRAINING BANKS FOR DIVERTING FLOOD WATERS. By E. A. Oosthuizen. (*Farmg. in S. Afr.*, xi., 120, 1936, p. 99.) A general account, with diagrams, showing the possibility of controlling flood waters at selected places by means of a system of training banks, and then distributing the water by contour-bank systems.

442. SOIL EROSION IN KENYA. By S. F. Deck. (*Trop. Agriculture*, xiii., 3, 1936, p. 57.) A discussion of the serious effects of soil erosion in Kenya and of some possible remedies. Erosion occurs in an aggravated form in the country

under the following conditions: (1) Where the rainfall is definitely seasonal—i.e., where there is a well-defined dry season of three months or more. (2) Where the annual rainfall is 30 inches or less. (3) Where the geological formation is schistose or a recent volcanic ash. (4) Where there is overstocking in the Native Reserves.

443. THE CONTROL OF SOIL EROSION IN THE UNION OF SOUTH AFRICA. (*Rhod. Agr. J.*, xxxiii., 1, 1936, p. 11.) An explanation of the various systems, and of the special facilities available to farmers under the official scheme.

CULTIVATION, IRRIGATION, GINNING, ETC.

444. INFLUENCE OF THE SPEED OF PLOUGHS ON THE QUALITY OF THE PLOUGHING AND ON THE CONSTRUCTION OF MACHINES. (*Monthly. Bull. of Agr. Sci. and Pract.*, Rome, xxvii., 3, 1936, p. T89.) Prof. Fantoni of Zagreb has made experiments, confirmed at Rothamsted and elsewhere, which show that a considerable increase in the speed of ploughing is accompanied by increased crop. The difficulty is to make the machine strong enough to stand the increased wear and shocks without making it too heavy.

445. THE DAIRY COW AND COTTON AS SOURCES OF INCOME FROM THE FARM. By J. S. Moore and W. C. Cowset. (*Mississippi Sta. Circ.* 96, 1935. From *Exp. Sta. Rec.*, 73, 6, 1935, p. 863.) Analysis is made of the results of a project entitled: "The Fourteen Acre, Four Cow, Five Year Programme," which had among its objectives the inclusion of dairy cows in the farm programme; the growing of practically all the feed for the 4 cows on the 14 acres; the growing of cotton as an additional cash crop; the improvement of the soil through crop rotation, the growing of winter cover crops, the turning under of legumes, and the use of barnyard manure; determination of whether more profitable land utilization is possible than under present average conditions; and determination of whether better distribution and more profitable employment of labour on the farm is possible.

During the five years all feed for the 4 cows, except 713 lb. of cottonseed meal, was raised on the farm; the total net return from crops was \$602.41; and the total net return from cows was \$530.62. Had the entire area suitable for cultivation been in cotton the net return would have been \$380.57. The required labour was more evenly distributed on the diversified farm than it would have been with cotton alone.

"The results as a whole show that combined dairy and cotton farming furnishes more revenue than cotton farming alone; that conditions are much more favourable for maintaining and increasing soil fertility; that we may utilize more land at a profit; that labour may be distributed throughout the year to better advantage; and that a complete failure in any year is not likely to occur."

446. COTTON CROP: GROWING AND MARKETING, FINANCING. By G. Costanzo. (*Int. Rev. Agr.*, 27, 1936, E1. From *Summ. of Curr. Lit.*, xvi., 7, 1936, p. 175.) The problem of financing the growers of cotton is discussed, and the systems employed in the United States, India, Egypt, Russia, China, Argentina, Brazil, Turkey and various cotton-growing regions of Africa are discussed.

447. UNIFORMITY TRIALS WITH COTTON. By F. Siao. (*J. Amer. Soc. Agron.*, 27, 1935, p. 974. From *Pl. Bre. Absts.*, vi., 3, 1936, p. 287.) The results of tests carried out in 1930-32 are reported. With regard to size of plot, it was found that increase either in width or length reduced the error, and there were indications that under the conditions of experiment wide plots were more desirable than long, narrow plots. Greater efficiency, however, was to be obtained by increasing the number of replications than by increasing plot size. The number of replica-

tions of plots of a given size required to reduce the standard error to 5 per cent. varied considerably with season, and so no definite number could be recommended. The standard error for ten replications in randomized blocks was less than that for eight replications in systematic arrangement with a check plot occurring every fifth plot. In comparing Latin squares with randomized blocks the variance was less in the former. The distribution of the differences between the assumed treatments was shown by the chi-squared test to conform with mathematical expectation in each case.

448. MEASUREMENTS OF THE LINT LENGTH OF COTTON UNDER FIELD CONDITIONS. AN APPARATUS CONSTRUCTED BY THE CENTRAL BREEDING STATION, NIHI. By O. Sokuraja-Vysotskaja. (*Bor'ba za Khlopok*, 8-9, 1935, p. 126. From *Pl. Bre. Absts.*, vi., 3, 1936, p. 288.) A cheap and simple device costing 1-15 roubles is described whereby measurements of lint can be made with deviations of not more than 1 mm. from measurements with Balls' apparatus. By its aid measurements on 500 seeds can be made and entered in the field during an 8-hour day by an unskilled worker.

449. STUDIES IN THE TECHNIQUE OF FIELD EXPERIMENTS. IV. A STUDY OF MARGIN EFFECT IN VARIETY TRIALS WITH COTTON AND WHEAT. By J. B. Hutchinson and V. G. Panso. (*Ind. J. Agr. Science*, v., 6, 1935, p. 671.) Studies are reported on the extent and importance of margin effect in variety trials on cotton and wheat. The cotton trials were grown under a range of different conditions including irrigated and dry, and black cotton soil and sandy soil. It is shown that the magnitude of the effect of margins on means depends primarily upon the extent of the differences between the varieties included in the trial. Where differences between varieties were great, margin effect was large, and failure to allow adequate plot margins would have resulted in the drawing of erroneous conclusions. Where differences between varieties were small, margin effect was small, and the inclusion in the plots of arcs, otherwise to be discarded as margins, caused a reduction in error which materially improved the efficiency of the experiment. It is concluded that where markedly different varieties are to be compared, one row on either side of each plot will be adequate for side margins. For end margins three to four feet should be provided at each end of each plot to allow for the effects of trampling, irregularities in sowing and possible mixing of seed. Where varieties to be tested are similar in habit, it is actually advantageous to dispense with margins, especially where other considerations make it desirable—e.g., where difficulties of control in outstations make simplicity essential—but in such cases it is most important to surround the experiment with guard rows of bulk crop to protect the outside plots. With the wide differences in treatment common in agronomic experiments, wider margins are probably necessary. The data show that in almost all varieties studied competition between varieties was less than between plants of the same variety. Where margins are dispensed with, therefore, yields will be somewhat overestimated.

450. PROGRESS IN THE STUDY OF THE MECHANICAL HARVESTING OF COTTON. By H. P. Smith *et al.* (*Bull. No. 511, Texas Agr. Exp. Station, 1935.*) The results are given of harvesting trials with a roll-type stripper sled, using different kinds and sizes of stripping rolls operated at different angles and speeds. Stripping rolls made of steel and wood having a slightly roughened surface gave a high efficiency in harvesting cotton. Rolls 56 inches in length, operated at an angle between 25 and 30 degrees with the ground, and having a peripheral travel faster than that of the forward travel of the tractor, were the most efficient of the different combinations of roll angles and speeds. Stripping rolls $2\frac{3}{16}$ inches in diameter were more satisfactory than rolls 3 inches in diameter.

The results of tests with the Texas Station Harvester show that the highest percentage of cotton was harvested when the high roll speed was used. In harvesting Ducona cotton the rubber rolls harvested 96.8 per cent. of the cotton, while wood harvested 92.0 per cent., steel 95.3 per cent. and knurled steel 96.2 per cent.

In cleaning mechanically harvested cotton in 1934, the Texas Station Bur Extractor and the Texas Station Cylinder Cleaner removed foreign material consisting of burs, green bolls, dirt and trash, amounting to approximately 50 per cent. of the weight of the harvested cotton. Ducona cotton cleaned by the process classed two grades higher than when cleaned by other equipment.

451. COTTON GINNING AND CLEANING MACHINE. By J. Harris. (E.P. 439, 576 of 11/6/34; 10/12/35. From *J. Text. Inst.*, xxvii, 2, 1936, A55.) Cotton fed to gin saws or on to a rotating brush having a surface formed by projecting steel wires is treated by a succession of rotating brushes that rotate alternately in opposite directions at progressively increasing speeds of rotation, and which are fitted alternately with ordinary bristles and with projecting steel wires, the cotton being removed from each brush by the next with which it is in contact, and being discharged from an opening in a casing partially surrounding the last brush by the draught created by this brush as it rotates.

COTTON SEED AND OIL.

452. THE CONVERSION OF COTTON SEED INTO COMPOST AND THE DISPOSAL OF SURPLUS COTTON SEED. By N. V. Rounce. (*E. Afr. Agr. Jour.*, i., 5, 1936, p. 352.) Describes the process which is carried out at Morogoro Experiment Farm, Tanganyika Territory.

Crop residues are stored for use as bedding in the cattle sheds, the used bedding being withdrawn every other day. If there is a concrete floor in the shed, the urine medium is obtained from the urine pit, or if the floor is of compacted earth, the urine-impregnated earth is scraped from the top 3 inches about every three months. Slurry is made of urine water from the pit, or water and urine earth, and a handful or so of ash, dung and inoculant. This inoculant is the fungus and bacterial medium obtained from a heap a stage ahead of the one in preparation. If the land on which the heap is to be built is dry, it is soaked first with water, then two alternate layers of bedding and cotton seed are spread 2 inches deep, each layer being moistened with slurry (two pailfuls are sufficient for one heap). The layers are continued until the heap is 2 feet high; then the whole is well watered. After a fortnight, if satisfactory heating has taken place and fungus growth has spread well throughout the heap, half the heap is turned and watered, and the balance is laid on top and watered again. Inoculant from a month-old heap is spread before the other half is turned over. The whole process is repeated at one, two, and three months.

Where there is a good water supply, bedding from six cattle will enable 80 tons of concentrated manure to be made annually, utilizing more than 50 tons of cotton seed. The cost should not exceed Sh. 2. per ton of compost produced. A heap 14 feet by 8 feet and 2 feet high requires about one ton of cotton seed, and the compost produced weighs about $1\frac{1}{2}$ tons; the amount of water required over the period of three months of compost manufacture varies from 500-700 gallons per heap. The cotton seed during the rainy season does not break down to quite the same extent as in the dry months, but all that is left of the hard seed-coat is the black, softened epidermis which soon disintegrates in the field.

453. THE ECONOMIC VALUE OF IMPROVED COTTON SEED. By L. E. Long. (*Mississippi Sta. Bull.* 307, 1934. From *Exp. Sta. Rec.*, 74, 1, 1936, p. 116.)

Reports the results found for the 1932 cotton crop in a project undertaken to determine the profitability of planting improved seed. Tables are included and discussed showing the comparative costs of production, value of cotton produced, and quantities and prices pertaining to production of cotton grown from different generations of seed for all varieties, Stoneville cotton, and Delta and Pine Land cotton, without fertilizer or manure, with manure and no fertilizer and with different amounts of fertilizer. The final conclusion drawn is that the planting of first and second generation cotton seed is justified by the financial returns.

454. COTTON SEED: LINT DETERMINATION. By E. Freyer. (*Oil and Soap*, **12**, 1935, p. 208. From *Summ. of Curr. Lit.*, xv., **24**, 1935, p. 651.) The amount of lint may be determined as follows: 15 gm. seed are steeped in 40 c.c. concentrated sulphuric acid for 45 seconds, the mixture is poured into 500 c.c. water, washed in a perforated cup under running water, and then drained and dried (e.g., at 130° C. under forced draught). The difference between the loss of weight on drying of the acid-treated and untreated samples is taken as lint. Duplicates should agree to within ± 0.3 .

455. COTTON SEED HULL DEFIBRATING MACHINE. By D. M. Haig. (Liverpool, E.P. 439,769, of 30/11/33. From *J. Text. Inst.*, xxvii., **4**, 1936, A160.) A description of the apparatus.

PESTS, DISEASES, AND INJURIES, AND THEIR CONTROL.

456. REPORT OF THE FOURTH IMPERIAL ENTOMOLOGICAL CONFERENCE, 19TH-27TH SEPTEMBER, 1935. (London. Imp. Inst. Ent., 1935. Price 4s. From *Rev. App. Ent.*, xxiv., Ser. A, **2**, 1936, p. 55.) The discussions that took place at the scientific meetings of the Conference are summarized, the subjects dealt with being: Locusts and Grasshoppers; Termites; Cotton Stainers and their Control; Sheep Blowflies; the Biological Control of Insect Pests; Pests of Stored Products; the Need for Forest Entomologists, with Special Reference to the Pin-hole Borer Problem; and Plant Viruses and their Insect Vectors.

457. EFFECT OF HOST DENSITY ON PARASITISM. By S. E. Flanders. (*J. Econ. Ent.*, xxviii., **6**, 1935, p. 898.) A convenient method of studying the effect of host density on parasitism has been developed in the course of mass production of the grain moth, *Sitotroga cerealella*, and its parasite *Trichogramma*. The effect is measured by the progeny per parasite and the percentage of parasitism under two series of environmental conditions. Each series is a duplicate of the other except that in one the host density and in the other the number of parasites liberated varied. A description is given of the technique employed. The results obtained in tests in which a total of 7,806 hosts was used showed that with increasing host densities the number of progeny per parasite increased until a maximum was reached and maintained. The number of progeny per parent becomes constant after the number of hosts within the sphere of action of the parasites exceeds the total reproductive potential of the latter. Within the limited area of the experimental units the number of progeny per parent decreased with the increase in the number of parasites liberated. This decrease was probably due to superparasitism. Superparasitism lowered the rate at which the progeny per female increased with host density, so that the rate of increase was inversely proportional to the number of parasites liberated. With single generations the maximum percentage of parasitism occurs when the host density is such that the number of hosts approaches the total reproductive potential of the parasites. At lower densities, the percentage of parasitism increases as more eggs become available. At high densities the percentage of parasitism decreases since the reproductive

potential is limited and is independent of the host density. With multiple generations occurring under natural conditions, the reproductiveness of the parasite is not so limited and continues to be dependent on host density, so that the increase in percentage of parasitism would be expected to continue.

458. THE COTTON OR MELON APHID ON COTTON. By J. G. Watts. (*S. Car. Exp. Sta. Rpt.*, 1935, p. 49.) Studies indicated that the most important factor in the natural control of the cotton aphid was a hymenopterous parasite, *Aphidus* (*Lysiphlebus*) *testaceipes* Cresson. Three weeks after the appearance of the pest, more than 75 per cent. of its numbers were attacked by this parasite. Another parasite of minor importance was *Pachyneuron siphonophoræ* Ashmead. The most important predators were the Convergent Lady Beetle (*Hippodamia convergens* Guer.), in both larval and adult stages, and the larvæ of the lacewing fly (*Chrysopa* sp.).

459. THE DISTRIBUTION AND SAMPLING OF INSECT POPULATIONS IN THE FIELD WITH SPECIAL REFERENCE TO THE AMERICAN BOLLWORM, *Heliothis obsoleta* FABR. By J. Marshall. (*Ann. of App. Biol.*, xxiii., 1, 1936, p. 133.) The problem associated with estimation of insect activity is discussed. A precision experiment, undertaken to investigate the nature of the egg-laying of the American bollworm, is described, and the nature of the distribution is investigated. Correlation trials between the two counts show that the same portions of the crop retain their relative attraction to the bollworm moth over short periods. The effect of subdivision of the area on the sampling error is analysed. Both egg as well as plant number figures per 3-yard length show a greater variation between than within rows. Correlation and regression coefficients prove a very close relationship between plant number and eggs laid. Eliminating the effect of plant number eliminates this greater variation for the first egg-count figures. In the second count the variation between rows is still significantly greater. The reason for this is discussed. Considerations affecting the sampling technique developed from the precision data are discussed. The sampling method is explained and two examples are given. From the analysis of these the system is shown to sample adequately the fields and fulfils the requirements of the survey.

460. EGYPT: CONTROL OF COTTON BOLLWORM. (*Egyptian Mail*, 24/3/36.) The Royal Agricultural Society of Egypt is offering a prize of £E20,000 for an effective remedy for the control of bollworm in all its stages. Any remedies which it is decided to test will be tried for six years before the prize is awarded. Particulars may be obtained from the Secretary of the Royal Agricultural Society, Cairo, Egypt.

461. DYAR'S RULE AS RELATED TO THE NUMBER OF INSTARS OF THE CORN EARWORM, *Heliothis obsoleta*, FABR., COLLECTED IN THE FIELD. By J. C. Gaines and F. L. Campbell. (*Ann. Ent. Soc. Amer.*, xxviii., 4, 1935, p. 445. From *Rev. App. Ent.*, xxiv., 3, 1936, p. 185.) The methods of Peterson and Haeussler of determining the number of instars in lepidopterous larvæ by collection of larvæ representing all the instars of a generation, measurement of the width of head capsules of the individuals, and classification of the measurements in frequency-distribution diagrams and its limitations, are discussed. This method was used to determine the number of instars of four generations of *Heliothis armigera* Hb. (*obsoleta*, F.) collected in Texas on susceptible crops. The first two generations were collected from maize, the third from maize and cotton, and the fourth from hegari (*Sorghum*). These were the crops most susceptible to attack by the broods collected from them. The frequency distribution of the head measurements showed that the larvæ from maize and hegari had six instars, whereas those from cotton had seven. It was thought that the larvæ from cotton had an additional instar

because this plant was less succulent than maize and hegari, and consequently was less suitable for their development. Seasonal temperatures appeared to have no effect on the number of instars, for the spring and two summer generations from maize had the same number of instars. The application of Dyar's rule for corroborating the number of instars observed in *H. armigera* was studied mathematically. Four methods were used to calculate progressions for comparison with the observed progressions of mean head widths. The calculated geometrical progressions were shown as straight lines on semi-logarithmic cross-section paper. By the method of least squares and by calculation of the standard errors of estimate it was shown that the mean head widths of the first generation of *H. armigera* fitted a geometrical progression of seven terms much better than one of six terms, the observed number. It was necessary to conclude either that the second instar of seven was overlooked, or that Dyar's rule was not valid for this particular case. It was concluded that Dyar's rule did not hold, because the progression in question was not unusual, as shown by a study of the literature. High growth ratios are often encountered in the early part of larval development, and there is a tendency for growth ratios to diminish during larval development. Examples from the literature are quoted to show that the application of Dyar's rule may indicate instars that do not exist, and its use for corroborating the number of instars observed is not recommended.

462. CORN EARWORM FAILS TO OVERWINTER AT AMES, IOWA. By R. E. Hutchins. (*J. Econ. Ent.*, xxviii, 5, 1935, p. 833.) No adults were found in the spring of 1935 in Central Iowa in screen cages placed over cultivated ground and over grass sod in the soil of which larvæ had pupated late in 1934. Pupæ dug up in cornfields in March were all dead. The ground was covered with 4 to 5 inches of snow during part of the winter of 1934-35, and the temperature dropped as low as 28° F. Up to July 6, 1935, no delayed emergence of adults had been observed. This would seem to lend considerable weight to the theory that the corn earworm does not overwinter as far north as Central Iowa.

463. LA CHENILLE ENROULEUSE DES FEUILLES DU COTONNIER, *Sylepta derogata* FABR. By D. Soyer. (*Bull. Agr. du Congo Belge*, xxvi., 3, 1935, p. 496.) A description of the leaf-rolling caterpillar, *Sylepta derogata*, and the nature of the injury caused to cotton. Control measures suggested are hand picking, clean cultivation, and dusting with powder containing Paris green or arsenate of lead. Light traps also are useful.

464. REPORT OF PROCEEDINGS OF THE INTER-STATE LOCUST CONFERENCE, PRETORIA, 30TH JULY TO 3RD AUGUST, 1934. This report has recently been received. The Conference was attended by delegates from the British dominions in South and Central Africa, from Angola and Portuguese East Africa, and from the Belgian Congo. A detailed account is given of the discussions, which dealt with improvements in methods of combating locusts, control by means of aeroplanes, location of permanent breeding grounds, and with organization and co-ordination of research to prevent overlapping.

465. THE DISTRIBUTION OF THE MIGRATORY LOCUST AND ECOLOGICAL STUDY OF ITS BREEDING GROUND IN CHINA. By T. L. Tsou. (In Chinese, with summary in English.) (*Agric. Sinica*, i., 8, p. 239. Nanking, 1935. From *Rev. App. Ent.*, xxiv., Ser. A, 1, 1936, p. 4.) In China, the area in which invasions of *Locusta migratoria* occur lies between the latitudes of the Gulf of Chili (39° N.) and Hangchow Bay (30° 30' N.). It is delimited by low winter temperatures (-6-1° C. [21-02° F.] in January) in the north, by mountains on the west, and by mountains and excessive precipitation (reaching 59 inches a year) in the south, where the invasions are checked directly by the rainfall and indirectly by parasitic fungi.

In the normal area the annual precipitation is 15½ to 18 inches, falling mainly in summer. The breeding-places of the swarms are concentrated along the sea coast and lake shores and in alkali lands, the vegetation of which is described, as well as in swamps and uncultivated lands, all of which are most common in the valley of the lower Yellow River and to the north of the Yangtse. The outbreaks usually take place when a dry summer and autumn are followed by a warm winter. The winter is passed in the egg stage, and there are two generations a year, the first hatching in May and the second in July.

466. DOS INIMIGOS DO GAFANHOTO VERMELHO. By J. G. A. Cardoso. (*Mozambique Docum. trim.*, **3**, p. 65. Lorenzo Marques, 1935. From *Rev. App. Ent.*, xxiv., Ser. A, **1**, 1936, p. 3.) A popular account of the natural enemies of *Nomadacris septemfasciata*, Serv., in Mozambique, containing good photographic and coloured plates showing locusts killed by *Empusa grylli*, *Sporotrichum* sp. and *Coccobacillus acridiorum*. Of the other natural enemies observed, brief descriptions of which are given, mites of the genera *Tyroglyphus* and *Rhizoglyphus*, *Stomatorrhina lunata*, F., *Scelio* sp., and *Epicauta* sp. are parasites of the eggs. A mite, *Erythraeus* sp., and *Mermis* sp. infest the adults and hoppers and *Sarcophaga* sp. the adults. The Tenebrionid, *Psammodes carbonarius*, Grst., destroys many eggs and even hoppers, and a Tettigoniid, *Acanthoplus armativentris* sp. n., also attacks the locusts.

467. ON THE IDENTITY OF *Lygus simonyi*, REUT., AND *Lygus vosseleri*, POPP., IN KENYA AND UGANDA. By W. E. China. (*Bull. Ent. Res.*, xxvi., **4**, 1935, p. 427. From *Rev. App. Ent.*, xxiv., Ser. A, **2**, 1936, p. 106.) An examination of the type material has shown *Lygus vosseleri* Popp. to be a synonym of *L. simonyi*, Reut. This Capsid is a pest of cotton in Uganda, where it has hitherto been known as *L. vosseleri*. The common coffee Capsid of Kenya, erroneously recorded as *L. simonyi*, is here described from the male as *L. coffeæ*, sp. n. Another species, which was taken on coffee in Kenya in 1932, is very similar in appearance to the true *L. simonyi*, but has certain distinguishing characters. It is possibly the species that Poppius erroneously regarded as *L. simonyi* when he described *L. vosseleri*.

468. NOTES ON *Lygus simonyi*, REUT. (CAPSIDÆ), A COTTON PEST IN UGANDA. By G. L. R. Hancock. (*Bull. Ent. Res.*, xxvi., **4**, 1935, p. 429. From *Rev. App. Ent.*, xxiv., Ser. A, **2**, 1936, p. 106.) Experiments in Uganda in which *Lygus simonyi*, Reut., was fed on caged cotton plants confirmed the assumption that this Capsid causes a loss of crop. It produces brown angular spots on the leaves, and these patches become dry and crack, giving a tattered appearance to the plant. The small apical buds become black and fall off, and the bolls, which are also spotted, crack and are eventually shed. The growth of the branches is retarded and the actual number of nodes appears to be reduced. The most serious damage was observed in two localities during very wet seasons, which encourage the growth of tall lanky plants. During 1933-34 plants growing on light soil, although rather small, showed excellent growth, and *Lygus* was almost completely absent, whereas plants grown on heavier soil where the rainfall was higher were seriously damaged when young, though they afterwards recovered and produced the better crop. Plants growing close to the base of large termite hills in one locality never suffered severe damage, and were unusually healthy, probably owing to better aeration and drainage. A Braconid, *Euphorus* sp., was bred once from a nymph of *L. simonyi*. The percentage loss caused by damage to young bolls by *Lygus* varied from 14.5 in 1928-29 to 26.2 in 1930-31.

469. PROTECTION FROM TERMITE ATTACK. (*Crown Colonist*, April, 1936, p. 184.) Complete success has attended the efforts of M. Maurice Descamps, a French

engineer, who used a new preparation in eradicating the termites which had done great damage to the woodwork of Napoleon's last home in St. Helena. In view of the enormous amount of destruction wrought by termites in tropical countries, the new method of treating structures already affected or in danger of attack is of widespread interest. A summary is given of the account appearing in the *London Times*.

The queen termite, the young and the "soldiers" depend entirely on the "workers" of the colony for their food. M. Descamps' method is to interpose a barrier between the non-worker termites and their commissariat. As the favourite route of the workers in reaching their sources of supply in the woodwork of a building is via tunnels in the walls, even through brick and cement, every vertical portion of a house under treatment is pierced at intervals along the floor level, and the special poison is allowed to saturate the inner structure. As an extra precaution the ground floors and the soil immediately beneath are sprayed with the liquid, through holes pierced in the boards, or else the floors are taken up. Finally, the outside walls are treated by sinking shallow holes close to them at half-yard intervals, and filling them with liquid, which sinks into the soil. The substance employed is made to a secret formula; it is not corrosive, offensive in smell, inflammable, explosive, or poisonous to human beings or animals. It has been found equally efficacious against the death-watch beetle.

470. AN ALLY OF THE COTTON GROWER—THE ACARIPHAGOUS THRIPS (*Scolothrips acariphagus* YAKH.). By V. V. Yakhontov. (In Russian.) (*Sotzial. Nauka Techn. No. 12*, p. 96. Tashkent, 1934. From *Rev. App. Ent.*, xxiv., Ser. A, 1, 1936, p. 18.) A detailed redescription is given of *Scolothrips acariphagus*, Yakh., a predacious thrips originally described from convolvulus. It has been found to be one of the most important of the natural enemies of the mite attacking cotton in Central Asia, which is here referred to as *Tetranychus telarius*, L. (*althææ*, v. Hanst.), and it has previously been erroneously recorded in this connection as *S. sexmaculatus* Perg. In 1928 it was particularly abundant near Old Bokhara and Tashkent.

471. SURVEY OF THE DISTRIBUTION AND PREVALENCE OF COTTON INSECTS IN CHINA DURING THE YEAR 1934. By F. C. Woo. (*Special Pubn. No. 12*, Nat. Agr. Res. Bur., Min. of Industries, Nanking, China, September, 1935.) (In Chinese, with summary in English.) A list is given of eighteen species of insects injurious to cotton in 1934. The most serious pests are pink bollworm, cotton bollworm, red spider, aphid, and cutworms. Aphid and cotton leaf roller are more injurious to American than to Chinese cotton, and this fact is one of the most serious obstacles to the extension of American cotton in China.

472. A PRELIMINARY STUDY OF THE INSECT PESTS OF COTTON IN THE PHILIPPINES, WITH SUGGESTIONS FOR THEIR CONTROL. By F. Q. Otones and F. L. Butac. (*Phil. J. Sci.*, 56, 2, 1935, p. 147. From *Exp. Sta. Rec.*, 74, 2, 1936, p. 229.) The chief pests dealt with include the Malayan cotton boll weevil, the cotton semi-looper, cotton pyralid leaf roller, a tortricid leaf roller, pink bollworm, cotton leaf miner, cotton stem weevil, mealy-lug, melon aphid, leaf hopper, stainers, thrips, red spider, and white fly.

473. THE MAJOR PESTS OF THE COTTON PLANT IN UGANDA. By G. L. R. Hancock. (*Uganda J.*, iii, 1, 1935. Kampala. From *Rev. App. Ent.*, xxiv., Ser. A, 1, 1936, p. 4.) This paper contains notes on the chief pests of cotton in Uganda, and particularly the types of injury they cause, and also a brief general discussion of the factors that influence the incidence of cotton pests on the crop, including isolation, climate, condition of the plant, period during which food supply is available, alternative food plants and natural enemies.

474. COTTON DISEASES IN THE PHILIPPINE ISLANDS. By J. S. Camus. (*Ann. Rpt. of Dir. of Plant Industry*, 1934. From *Rev. App. Mycol.*, xv., 2, 1936, p. 79.) Preliminary studies indicate that cotton leaf curl is spread locally by cotton leaf hoppers (*Empoasca flavescens*). Cotton leaf spot (*H. gossypii*) is present in Manila and Silang, where it may have been introduced by imported seed.

475. DISSEMINATION OF THE BACTERIAL LEAF SPOT ORGANISM. By F. M. Rolfs. (Abstr. in *Phytopathology*, xxv., 10, 1935, p. 971. From *Rev. App. Mycol.*, xv., 4, 1936, p. 214.) Seed has been found to be the source of both primary and secondary infection of the cotton crop by *Bacterium malvacearum*. Internal seed infection may occur either directly while the boll is quite young, or indirectly by the entry of contaminated water through a break in the outer seed coat of mature seed at the micropyle.

Water is an important agent of dissemination. The bacteria were carried 980 feet in rill water. The green leaf bacteria are capable of independent movement over a radius of 12 inches or more in still water. The age limit of free bacteria in distilled water is about 60 hours. The life of the organisms is shortened by soluble soil salts in contaminated pool water. The more exposed parenchyma infections tend to be eliminated by hot, dry weather, the leaf spots becoming less angular and vascular invasion developing more prominently. The accumulation of the bacteria in the veins and midrib hastens leaf-shedding and affords better protection for the parasite from adverse weather conditions. Wind also plays an active part in dissemination. A single whirlwind scattered the infected dry leaf material over an area of 100 acres in 20 minutes.

476. THE ETIOLOGY OF DAMPING-OFF OF COTTON SEEDLINGS. By C. H. Arndt. (Abstr. in *Phytopathology*, xxv., 10, 1935, p. 968. From *Rev. App. Mycol.*, xv., 3, 1936, p. 149.) *Glomerella gossypii* was responsible for heavy losses among cotton seedlings in 1934 in South Carolina, where greenhouse studies showed that it may cause damping-off at soil temperatures up to 30° C. *Fusarium* spp., though representing 15-75 per cent. of the organisms isolated from diseased hypocotyls, do not appear to be the cause of appreciable losses in the stands, and the same is true of *Rhizoctonia* (*Corticium solani*), which was found on less than 10 per cent. of the infected material examined during the last ten years. In one field *Pythium ultimum* was observed to be a common agent of reduced germination and impoverished stand.

[Cf. Abstr. 132, Vol. XIII. of this Review.]

477. ÉTUDE DU SHEDDING EN RAPPORT AVEC LA "FRISOLÉE" DU COTONNIER. By R. L. Steyaert. (*Bull. Agr. Congo Belge*, xxvi., 1, 1935, p. 3. From *Rev. App. Mycol.*, xv., 3, 1936, p. 147.) A full account is given of the author's detailed study of the shedding of cotton floral buds and bolls in the Belgian Congo in relation to physiological and meteorological factors and the disorder termed "frisolée." The results obtained (which are tabulated) showed that the intensity of the shedding is correlated with the stage of growth reached by the organs concerned, and that the dropping of the floral buds is directly affected by drought, that of the bolls being due to the indirect action of soil moisture on the osmotic strength of the cell sap. Frisolée becomes most intense when shedding reaches a maximum. The first symptoms appear when boll formation begins, and take the form of a late season tomosis, the leaves as soon as they open showing perforation in the blade or even lacerations completely separating the veins. If the whole leaf surface is affected the leaf has a flattened appearance, but if only part is attacked the resulting growth inequalities produce malformations and distortions. The internodes of the boll-bearing branches are shortened and axillary buds are formed. The top parts of the plants either produce no bolls or misshapen ones. Plants in

a strongly vegetative phase are the most susceptible. Control would appear to consist in the selection of resistant lines.

478. APPARATUS AND PROCEDURE FOR SEPARATING COTTON ROOT ROT SCLEROTIA FROM SOIL SAMPLES. By C. H. Rogers. (*J. Agr. Res.*, 52, 1, 1935, p. 73.) The sclerotial stage of the cotton root rot fungus, *Phymatotrichum omnivorum* (Shear) Duggar, is one of the most important means of perpetuating the root rot disease in Texas. Sclerotia in the Houston clay soils of Central Texas vary in size from less than a millimetre to a centimetre or more. Apparatus and procedure for the rapid mechanical separation of sclerotia from soil samples are described. In the initial machine separation, the soil is reduced to a finely divided state by the aid of water and a rotary agitator in a coarse-mesh cylinder screen. The material passes on to a finer screen partially submerged in water and moving in a reciprocating manner. As much as $\frac{1}{2}$ gallon to 1 gallon of residue consisting of shell, gravel, and sclerotia remain in both screens when a barrel-size sample of soil is mechanically separated. The sclerotia are floated from the heavier shell and gravel residue by stirring in a sugar solution with a specific gravity of 1.15 to 1.25. The sugar solution does not affect the viability of the sclerotia.

479. RELATION OF THE OCCURRENCE OF COTTON ROOT ROT TO THE CHEMICAL COMPOSITION OF SOILS. By G. S. Fraps and J. F. Fudge. (*Bull. No. 522, Texas Agr. Exp. Sta.*, 1935.) Soils in which cotton root rot generally occurs and causes much damage are high in fertility, as indicated by their content of nitrogen, phosphoric acid, and potash. They are also high in basicity, contain considerable quantities of lime, and are alkaline in reaction and heavy in texture. Soils on which cotton root rot rarely occurs are generally low in fertility, have a low basicity, are neutral to slightly acid in reaction, and are light in texture. Alluvial, or river bottom, soils are usually high in fertility and basicity, but the disease does not generally occur on these soils. This indicates the action of inhibitory factors in alluvial soils not usually operative to the same degree in heavy upland soils. The chemical composition of local areas of soil containing active root rot may be almost identical with that of adjacent soils in which root rot is not present. Chemical composition is simply one of a number of factors influencing occurrence and virulence of the disease.

480. CONTROL OF POTASH HUNGER AND FUSARIUM WILT IN COTTON. (Abstr. in *Phytopathology*, xxv., 10, 1935, p. 969. From *Rev. App. Mycol.*, xv., 3, 1936, p. 149.) Of the eighteen cotton varieties resistant to wilt (*Fusarium vasinfectum*) tested in 1934 in Western Arkansas, five—viz., Cleve wilt 33-6, Dixie 14, Rhyne's Cleve wilt 33-10, Coker's Cleve wilt 3, and Rhyne's Cleve wilt—showed 4 to 8 per cent. infection compared with 29 to 44 per cent. for the five most susceptible, namely, Startex, Acala 1114, Super Cleveland, Trice, 304, and Half and Half. Among the 36 varieties studied in the eastern part of the State, the incidence of infection ranged from 1 per cent. in Rhyne's Cleve wilt to 49 per cent. in Half and Half, the susceptible varieties consistently falling into the low-yielding group.

The result of five years' experiments indicates that the control of potash hunger or "rust" by the application of potash-containing fertilizers leads to a marked decrease, in Central and Eastern Arkansas, in the severity of wilt attacks. In 1933 and 1934 the use of a resistant variety, Rowden 2088, combined with potash applications, gave the best control of "rust" and wilt.

481. THE VERTICILLIUM WILT DISEASE OF COTTON. By L. F. Miles. (Abstr. in *Phytopathology*, xxv., 10, 1935, p. 972. From *Rev. App. Mycol.*, xv., 3, 1936, p. 150.) Cotton wilt (*Verticillium albo-atrum*), first reported from Mississippi in 1930, has been found in nine counties of the State and also in Tennessee, Arkansas, California, Oklahoma, and Virginia, as well as in Greece. In July, 1933, field

inoculations were made with strains of the fungus from (1) cotton in Mississippi, (2) cotton in California, and (3) Irish potatoes in Canada. The Mississippi strain produced severe infection of all the plants in a fortnight, that from California caused relatively mild symptoms on 16 per cent., while the Canadian strain gave negative results. The mottling and blotching characteristic of the Mississippi strain did not develop in plants infected by the Californian form. Neither strain proved pathogenic during hot, dry weather in August. On potted greenhouse tomatoes inoculated with the same strains in the spring of 1933, the Canadian caused much more severe and earlier symptoms than either of the others, but the latter were much more virulent than the Canadian form on eggplants, snapdragons (*Antirrhinum majus*), beets, and California poppy. The Californian strain differs from the others in producing no microsclerotia in culture.

482. NOTA SOBRE O "DIPLODIA" DO ALGODOEIRO. By N. Azevedo. (*Rodriguesia*, i., 2, 1935, p. 97. From *Rev. App. Mycol.*, xv., 4, 1936, p. 215.) In 1933 cotton growing in experimental plots in Rio de Janeiro was found to show varying degrees of boll infection by a *Diplodia* with the characters of *D. gossypina*, not previously recorded on cotton bolls in Brazil.

483. PLANT VIRUSES. By K. M. Smith. (Methuen and Co., Ltd., London. 1935. Price 3s. 6d. From *Pl. Bre. Absts.*, vi., 3, 1936, p. 333.) In the brief compass of 100 pages the author succeeds in setting out before the reader the main facts associated with the technique of virus study, the modes of transmission, immunity, and control, and the nature of viruses.

GENERAL BOTANY, BREEDING, ETC.

484. SCIENCE OF THE YEAR, 1935: THE BIOLOGICAL SCIENCES. By W. B. Brierley. (Reprint received from the author.) The usual valuable and interesting summary of the work of the year in connection with Human Evolution, Cytogenetics, Zoology, General Physiology, Botany, Microbiology and Disease. Many important International Congresses were held during the year, including those concerned with Soil Science, Botany, Entomology, and Zoology.

485. CAMBODIA COTTON FLOWER PIGMENTS. By K. Neelakantam *et al.* (*Proc. Ind. Inst. Sci.*, 1935, 1A, p. 887. From *J. Text. Inst.*, xxvii., 2, 1936, A96.) Although Cambodia cotton flowers are pale ivory in colour they contain 3 per cent. of pigment. This consists mainly of quercimeritrin and quercetin in relative amounts that vary from season to season.

486. MEMOIRS OF THE COTTON RESEARCH STATION, TRINIDAD. (Pubd. by the Empire Cotton Growing Corporation, price 2s. 6d. post free.) The seventh number of Series B, Physiology, has recently been issued, and contains the following papers reprinted from the *Annals of Botany*:

FURTHER STUDIES ON TRANSPORT IN THE COTTON PLANT—Pt. III.: "Concerning the Independence of Solute Movement in the Phloem." By T. G. Mason, E. J. Maskell, and E. Phillis. The existing theories of phloem transport are discussed, and it is argued that neither the Münch theory of mass flow nor the De Vries-Curtis theory of protoplasmic streaming give a satisfactory explanation of the known facts. It is pointed out that in the cotton plant movement of carbohydrates from the mesophyll into the sieve-tubes appears to involve concentration of sugars, energy for this work being provided by metabolism of the transition cells. It is urged that we must consider the probability of further metabolic energy being used to accelerate the spread along the sieve-tubes of the sugars and other phloem-mobile nutrients. No suggestion can at present

be made as to the mechanism by which either the concentration by the transition cells or the acceleration of diffusive spread along the sieve-tubes is brought about, but it seems that the two phenomena may be in some way linked up.

In order to test further the analogy with diffusion, which involves independent spread of different materials along the sieve-tube path, examination is made of certain special transport situations in which carbohydrates and nitrogen might be moving in opposite directions along the phloem track.

Movement along the petiole. (a) Starch tests indicate a slow import of carbohydrate by mature darkened leaves that are in phloem connexion with illuminated leaves. Similar leaves isolated by ringing from the illuminated foliage show no import. (b) Darkened leaves isolated by ringing from illuminated foliage show a continued loss of total carbohydrates and of nitrogen. Similar leaves on unringed shoots show a much smaller initial loss followed by recovery. Total carbohydrates and nitrogen behave similarly, but in neither case is the gain statistically significant. Although, therefore, there are grounds for thinking that darkened cotton leaves can import carbohydrates via the phloem, there is no evidence as yet that they can at the same time export nitrogen via the phloem.

Movement of mineral nitrogen up the stem. Ringing experiments on the uptake and upward movement of mineral nitrogen in plants whose transpiration rate has been drastically reduced by defoliation, and the maintenance of a humid atmosphere, show that even under these conditions the xylem alone is able to transport upwards as much nitrogen as ascends via the intact stem, while evidence of upward movement via the phloem only was not obtained. It is concluded that the phloem can take little, if any, share in the normal upward movement from the roots of mineral nitrogen.

Movement of storage nitrogen and other reserves up the stem. (a) It is shown that when cotton plants grown in full nutrient solution are deprived of their nutrient supply, nitrogen and other nutrients are exported from the foliage of the basal region and move *upward* to the apical region. The data show that there is at the same time *downward* movement of carbohydrate via the phloem from apical to basal regions and roots. This export of nitrogen from the basal region is entirely prevented by ringing the stem above and below the basal region, a result which suggests that in the normal plant the mobilized nitrogen which reaches the apical region is moving up via the phloem in opposition to the downward movement of carbohydrates.

(b) It is shown, however, that an alternative theory—of ascent of mobilized nitrogen entirely via the xylem—cannot be excluded, for the mobilized nitrogen might have all passed via the phloem to the roots, been liberated there into the xylem, and so ascended to the apical region. This explanation will fit the facts observed if we accept the proviso that this liberation of nitrogen into the tracheæ is restricted to the root region and takes place there only while there is phloem connexion with the foliage.

(c) The behaviour of phosphorus is similar to that of nitrogen, and is susceptible of the same alternative explanations, with the exception that liberation of phosphorus into the tracheæ can apparently occur in a root region isolated from the foliage.

(d) In the case of potassium, ringing has little effect on upward movement of reserves from basal to apical regions, though it stops export to the roots. It would seem that, unlike nitrogen and phosphorus, potassium exported from the foliage via the phloem is fairly easily liberated into the tracheæ of the stem. It is concluded that most if not all of the upward movement of stored potassium can occur via the xylem.

(e) There is no evidence of remobilization of calcium.

It is concluded that the upward movement of stored nitrogen may be an

example of upward movement via the phloem in opposition to the downward movement of carbohydrates, but that until more is known as to the conditions determining liberation of stored nitrogen into the tracheæ, the alternative of upward movement entirely via the xylem cannot be excluded.

Pt. IV.: "On the Simultaneous Movement of Solutes in Opposite Directions through the Phloem." By E. Phillis and T. G. Mason. Cotton plants were grown in water culture for two and a half months with a full nutrient solution. At the end of this period all nutrients except calcium and iron were omitted from the solution. The plants were thus starved of the phloem-mobile elements, nitrogen, phosphorus, potassium, etc. At the beginning of the experiment, which lasted for fourteen days, the plants consisted of the root and the main axis with its leaves. The main axis was divided into an apical and a basal region. There were two groups of plants, both of which were ringed below the basal region. In one group, an additional ring was made between the apical and basal regions. The former was termed the Normal and the latter the Ringed group. The basal leaves of both groups were covered with paper bags with a view to arresting photosynthesis. It was found that nitrogen travelled upwards in considerable amounts from the basal to the apical region of the Ringed group. It is inferred that some, at least, of the nitrogen that entered the apical region of the Normal group travelled upwards in the phloem. It was also found that carbohydrate travelled downwards in the phloem from the apical region of the Normal group and entered the basal region. It is concluded that nitrogen and carbohydrate may travel simultaneously in opposite directions through the phloem.

487. PRELIMINARY STUDIES IN THE ANATOMY OF THE GYNÆCIUM OF COTTON WITH REFERENCE TO BOLL DEHISCENCE. By P. Abraham. (*Proc. Ass. Econ. Biol.*, Coimbatore (1934), 1935, 2, p. 22. From *Pl. Bre. Absts.*, vi., 2, 1936, p. 112.) The degree of opening of the boll is a character of great economic importance in cotton, and certain forms such as Karunganni (*G. indicum*, Gammie) and other members of the Nanking group have faulty or incomplete dehiscence of the boll. Anatomical investigations showed that the degree of opening was dependent on the extent to which the marginal (ventral) bundles of the carpels were fused in the placenta; in bolls which open fully the bundles are fused only for a short distance at the base of the placenta, but in *G. indicum* fusion extends higher up the placenta.

In crosses between *G. indicum* and *G. N. roseum* or *G. sanguineum*, forms with fully opening bolls, the F_1 plants all had fully opening bolls, with placental bundles fused only for a short distance, while in the F_2 segregation was observed in the ratio 3 fully opening : 1 incompletely opening. Studies are in progress on the F_2 population to determine whether the anatomical structure is inherited in the same way as boll opening, as is to be expected.

Since the character "boll opening" appears to be inherited in a simple Mendelian fashion, there should be no obstacle to breeding it into Indian cultivated races of cotton.

488. THE DEVELOPMENT OF THE COTTON EMBRYO. By R. G. Reeves and J. O. Beasley. (*J. Agr. Res.*, 51, 10, 1935, p. 935.) A study was made of the anatomical and chemical development of the cotton embryo in relation to its rate of growth. The early anatomical development was found to be somewhat irregular, but it showed certain similarities to the early embryonic development of *Malva rotundifolia* as reported by Souèges. Details of the development of the resin glands were studied. Indications of gossypol were found much earlier in the development of these glands than had been previously reported.

Most of the organs and tissues began their development during the latter part of the formative period, and the first part of the grand period of growth.

On or before the eighteenth day, oil, starch, pentosans, gossypol, and proteins were formed. All of these materials, except starch, were found throughout the remainder of the growth period. Glucose was not clearly demonstrated in the embryo at any time during the entire period of development, but it was found in the young lint hairs from the time of their first appearance until just before maturity. A high degree of variation in rate of growth and in size of embryos within the same boll was found, in spite of the fact that the material was thought to be relatively pure and the flowers had been self-fertilized. Numerous irregularities in form were observed in mature embryos.

489. INTRACAPSULARY BOLLS IN ASIATIC COTTON. By R. E. Beckett. (*J. Agr. Res.*, 51, 9, 1935, p. 839.) The presence of supernumerary carpels in cotton bolls is not an uncommon abnormality in most types and strains of cultivated cottons. Usually the growth is limited to a white slender body extending through the centre of the boll from the base almost to the apex. However, at Bard, California, in 1932 and 1933, this abnormal growth was observed in various degrees of development in a large proportion of the bolls of a strain of *Gossypium herbaceum*, introduced from Tashkent, Uzbek, U.S.S.R. In some of the bolls the growth was developed to the extent of forming small intracapsulary bolls containing from one to three mature seeds which were covered with lint of fair quality. These intracapsulary bolls closely resembled the bolls in which they were contained in appearance, colour, and shape. As viewed from outside they appeared to be divided into two to four carpels, but the placentae were not sufficiently developed to form separate carpels. The abnormal boll growth observed in this strain of *Gossypium herbaceum* appears to be a hereditary character, but of such a nature that its expression is largely influenced by environmental conditions. The environmental effects are shown by the increase in the percentage of bolls containing supernumerary carpels, and in the development of intracapsulary bolls as the season advanced.

490. 43-F—A NEW EARLY MATURING STRAIN OF PUNJAB-AMERICAN COTTON. (*Dpt. of Agr., Punjab, Leaflet No. 126*. 1935. From *Pl. Bre. Absts.*, vi., 3, 1936, p. 225.) Earliness, jassid resistance, good lint and staple length, and a yield superior to 4-F are the main features of this new cotton which is now ready for distribution.

491. COTTON VARIETIES RECOGNIZED AS STANDARD COMMERCIAL VARIETIES. By H. B. Brown. (*J. Amer. Soc. Agron.*, 28, 1935, p. 69. From *Pl. Bre. Absts.*, vi., 3, 1936, p. 286.) Descriptions are given of the origin and characters of thirty-one varieties of cotton recognized as standard commercial varieties by the American Society of Agronomy and the Agronomists of the Association of Southern Agricultural Workers.

492. NEW VARIETIES OF COTTON FOR THE FERGANA VALLEY. By I. N. Piscugin. (*Borba za Khlopok*, Nos. 8-9, 1935. From *Pl. Bre. Absts.*, vi., 3, 1936, p. 287.) Kolknoznik, No. 5F, Pima F. and Kim No. 2017 are the most suitable strains. [*Cf. Abstr. 454*, Vol. XII. of this Review.]

493. THE RESULTS OF COTTON VARIETY TESTS CONDUCTED IN THE COTTON REGIONS OF THE CENTRAL ASIATIC REPUBLICS OF THE U.S.S.R. By J. A. Naghibin. (*Bull. All-Union Sci. Res. Cott. Inst. (NIHI)*, Tashkent, 1, 1935. From *Pl. Bre. Absts.*, vi., 3, 1936, p. 288.) A collective work dealing with the variety tests carried out over large areas in which the new strains evolved by the breeding stations have been compared with the old varieties. Yield and lint quality were the characters to which the chief attention was paid, and the figures for the different varieties in different regions in this respect are tabulated, and

the results described. Many of the early maturing varieties are promising, especially the new strain Kolkhoznik.

494. THE BACKCROSS METHOD IN PLANT BREEDING. By F. N. Briggs. (*J. Amer. Soc. Agron.*, **27**, 1935, p. 971. From *Pl. Bre. Absts.*, vi., **3**, 1936, p. 238.) In emphasizing the value of the method of repeated back-crossing, particularly in transferring specific characters from one form to another, the author brings forward theoretically derived figures to show how much greater are the chances of recovering the parental form in this way than by inbreeding the hybrid. The method is particularly useful in adding disease and insect resistance to standard varieties. When it is desired to add resistance to two different diseases, separate programmes should be mapped out for each disease, and the end products crossed together.

495. INTERSPECIFIC HYBRIDIZATION IN GOSSYPIMUM AND THE MEIOTIC BEHAVIOUR OF F₁ PLANTS. By J. M. Webber. (*J. Agr. Res.*, **51**, **12**, 1935, p. 1047.) In *Gossypium*, cross-pollinations made in the morning are more successful than those made in the afternoon. Those made in the late summer are more successful than those made in early summer. By removing the entire corolla and andræcium during emasculation, rather than the anthers only, the percentage of successful cross-pollinations is greatly increased.

The correlation of the degree of compatibility between different species with their morphological similarity is often very limited. It is often less difficult to obtain hybrids between species of different taxonomic groups than between species of the same taxonomic group.

Hybrids between and within the following five morphologically distinct groups of *Gossypium* are described: (1) cultivated American species ($n=26$); (2) wild American species ($n=13$); (3) cultivated Asiatic species ($n=13$); (4) a wild Australian species, *G. Sturtii* ($n=13$); and (5) *Thurberia thespesioides* ($n=13$), a wild American plant, possibly congeneric with *Gossypium*.

Usually, in interspecific *Gossypium* hybrids the morphological similarity of the parental species, and the normality of the heterotypic divisions are correlated. Also, the degree of fertility is correlated with the amount of chromosome pairing.

Certain characters show a tendency to dominance in interspecific hybrids of *Gossypium*. Other characters are expressed in a more or less intermediate degree.

Interspecific hybrids within the same group exhibit normal meiotic behaviour. Hybrids between species having 26 pairs of chromosomes, like their parents, occasionally form quadrivalent chromosomes. Although hybrids between cultivated American and wild American species generally form 13 bivalent and 13 univalent chromosomes, they also occasionally form quadrivalent chromosomes. The latter behaviour is also characteristic of a natural hybrid between an Asiatic and a cultivated American cotton. *Gossypium barbadense* $\times$ *Sturtii* usually exhibits no chromosome pairing, but occasionally as many as 4 bivalent chromosomes have been observed. Hybrids between wild American species and *G. Sturtii* likewise exhibit variable pairing. In the latter case, however, pairing is more frequent. Hybrids between *Thurberia thespesioides* and *G. Sturtii* exhibit no chromosome pairing.

The occurrence of limited chromosome pairing in hybrids between wild American species and *Gossypium Sturtii* and the formation of quadrivalents in hybrids between cultivated American and wild American species, and in a natural hybrid between an Asiatic and a cultivated American cotton, seem to support the hypothesis that the species having 13 pairs of chromosomes are modified tetraploids. If such is the case, then the lack of pairing in *Thurberia thespesioides* $\times$ *G. Sturtii* must indicate that the chromosomes within the haploid

sets of these two species have differentiated genetically to such an extent that pairing within either haploid set is impossible.

The formation of 13 bivalent chromosomes in hybrids between cultivated American and wild American species and in a natural hybrid between an Asiatic and a cultivated American cotton, and the very limited pairing in *Gossypium barbadense* × *Sturtii* support the hypothesis that the species having 26 pairs are allotetraploids. Such an origin possibly involved species or close allies of some two of the following groups: Wild American species of *Gossypium*, *Thurberia thespesioides*, and Asiatic species of *Gossypium*.

496. TECHNIQUE L'AUTOFECONDATION ET DE L'HYBRIDATION DES FLEURS DU COTONNIER. By L. Soyer. (*Serie Tech. No. 3. Inst. Nat. pour l'Étude Agonomique du Congo Belge, Bruxelles, 1935.*) The following methods of selfing cotton are described: (1) prevention of the flowers from opening, by string, gum, ringing, or stitching; (2) isolation of the flower by bagging; (3) isolation of the plants by cultures in cages, or by leaving great distances between plots.

In addition to the usual method of emasculation, a new technique is described. This consists in the removal by the fingers of the entire corolla and staminal column as a whole. The style is subsequently isolated by slipping a piece of straw 1 inch long over it.

497. PURE-LINE COTTON: SPINNING TESTS. By J. H. Moore and R. T. Stutts. (*Cotton U.S.*, 99, 12, 1935, p. 41. From *J. Text. Inst.*, xxvii., 3, 1936, A97.) Yarn spun from cotton grown from registered seed, direct from the North Carolina Experiment Station, showed the highest breaking strength, and yarn from cotton grown under farm conditions from mixed seed the lowest strength. Exposure of the pure strain of cotton to farm conditions for two to four years resulted in a decrease in staple length and an impairment in the strength of the derived yarns.

FIBRE, YARN, SPINNING, WEAVING, ETC.

498. BRITISH COTTON INDUSTRY RESEARCH ASSOCIATION. (*Commercial Oldham*, ix., 12, 1936, p. 21.) An interesting sketch of the development and progress of the Shirley Institute from the opening of the first block of laboratories in 1922 up to the present time.

499. BRITISH COTTON INDUSTRY RESEARCH ASSOCIATION. (*Text. Wkly.*, xvii., 421, 1936, p. 362.) The new laboratories and experimental workrooms of the Shirley Institute were opened by Lord Derby in March last, and the Institute now possesses facilities second to none in the world for still further pursuing its valuable research work on behalf of the cotton and rayon industries of Lancashire.

500. COTTON FIBRES: DEGREE OF MATURITY: DETERMINATION. By A. P. Sakostschikoff. (*Faserforschung*, 12, 1935, p. 22. From *J. Text. Inst.*, xxvii., 4, 1936, A179.) A description is given of a method for determining the degree of maturity of cotton fibres based on the capacity of the dry fibre, on swelling in an alkali solution, to regain its original cylindrical shape. After treatment with alkali, the fibres are washed and stained with a 1 per cent. aqueous solution of Congo red. Microscopic examination reveals the following classes: (1) mature fibres of cylindrical shape and stained a deep red; (2) partially mature fibres, also a deep red, but showing convolutions; (3) immature fibres showing convolutions, and stained a pale rose; (4) dead fibres, unstained, and ribbon-like in shape. The derivation of the cellulose content from the degree of maturity is demonstrated.

501. A DEVICE FOR SEPARATING DIFFERENT LENGTHS OF FIBRES FROM SEED COTTON. By H. C. McNamara and R. T. Stutts. (*U.S. Dpt. Agr. Circ.* 360,

1935. From *Exp. Sta. Rec.*, 74, 2, 1936, p. 190.) The comb type of sorter described, with instructions on its operation, was developed to array the fibres from one cotton seed at a time. Observations on breakage and slippage of fibres during sorting, loss of fibres in combing, and on the effects of curvature of the seed on fibre measurements, are reported on briefly, with a description of a simple device which facilitates measuring individual fibre groups of an array.

502. LES MÉTHODES DE MENSURATION DE LA LONGUEUR DES FIBRES DE COTON. By L. Soyer. (*Serie Tech. No. 2. Inst. Nat. pour l'Etude Agronomique du Congo Belge, Bruxelles, 1935.*) Methods of measuring lint length are briefly discussed under the following heads: pulling; projection; measurement of individual fibres; the halo method; the weighing method; mechanical methods—e.g. the Balls and Baer sorters.

503. COTTON FIBRE: TESTING. American Society for Testing Materials. (*Proc. A.S.T.M.*, 35, 1, 1935, p. 1202. From *J. Text. Inst.*, xxvii, 3, 1936, A128.) A "tentative standard" specification of methods for performing the following tests: (a) sorter diagram analyses; (b) fibre weight per inch; (c) immaturity count; (d) breaking load of tufts. In the last the standard tuft is 0.0012434 sq. in. in area, and the corrected machine reading is divided by this to give "strength per sq. in."

504. A STRESS-EXTENSION RECORDING DYNAMOMETER FOR TEXTILE FIBRES. By D. de Meulemester and I. Nicoloff. (*J. Text. Inst.*, xxvii, 3, 1936, T84.) A description is given of a self-recording dynamometer for textile fibres that records the load and the extension mechanically on diagrams with rectangular co-ordinates, without error due to the extension of the fibre or to friction of the recording apparatus.

505. DIFFERENTIATION OF TEXTILE FIBRES. By J. F. Holmes. (*Text. Wkly.*, xvii, 1936, 409, p. 11, 416, p. 217.) A useful reference paper for those requiring to identify textile fibres. Both microscopical and reagent tests are given.

506. A DEVICE FOR MOUNTING COTTON HAIRS FOR EXAMINATION OF FIBRE-MATURITY. By N. Ahmad and A. N. Gulati. (*J. Text. Inst.*, xxvii, 4, 1936, T109.) An illustrated description of the device.

507. COTTON HAIRS: STRUCTURE. By K. Kusebauch. (*Textilber.*, 17, 1936, p. 18. From *J. Text. Inst.*, xxvii, 4, 1936, A178.) Sieber's Victoria Blue dyeing test for the differentiation of raw and bleached cottons is discussed, and it is pointed out that only the cuticle or incrusting substances and the lumen or its contents are dyed by Victoria Blue B, the actual cellulose of the cotton hair remaining undyed. On after-treatment with benzo-purpurin the lumen acquires a red colour whilst the cuticle remains blue. Observations are facilitated by the use of a microscope, and by subjecting the hairs to a swelling treatment in cuprammonium solution. The test can be used, not only for the detection of bleached cotton, but also for the differentiation of different types of cotton. Cottons of different origin differ in the thickness of the cuticle, and in the amount of lumen substances, and therefore behave differently towards Victoria Blue B, the depth of shade being greater on Indian than American cottons, which in turn dye darker than Egyptian cottons. Photomicrographs of raw, scoured and bleached Indian, American and Egyptian cottons are given and discussed.

508. A TABLE FOR TRANSFORMING THE CORRELATION COEFFICIENT, r TO z FOR CORRELATION ANALYSIS. By H. H. Love. (*J. Amer. Soc. Agron.*, 27, 10, 1935, p. 807. From *Exp. Sta. Rec.*, 74, 2, 1936, p. 179.) This contribution from Cornell University sets forth a table for transforming the correlation coefficient, r to z , for use in correlation analysis in accordance with the methods presented by Fisher.

509. THE MECHANICAL CALCULATION OF STANDARD DEVIATIONS AND CORRELATION COEFFICIENTS. By G. A. R. Foster. (*J. Text. Inst.*, xxvii., 2, 1936, T37.) In tests of textile materials such as, for example, the measurement of the regularity of yarns or rovings, or the measurements of the breaking loads of single threads, it is often necessary to calculate the mean and standard deviation of large numbers of observations. This always involves a considerable amount of labour, and, combined with the work of taking and writing down the observations, may seriously restrict the number of tests that can be undertaken. This paper describes some machines that perform the calculation automatically.

510. STATISTICAL METHODS IN SPINNING AND WEAVING. By L. H. C. Tippett. (*Text. Wkly.*, xvii., 410, 1936, p. 49.) Deals with the subject under the following heads: general uses of statistical surveys; surveys of productive efficiency and work of operatives; snap-reading method; surveys of yarn count variations; the measurement of variation; length of test specimen; results.

511. A TEXTILE STANDARDS ASSOCIATION WANTED. (*Text. Rec.*, liii., 633, 1935, p. 20.) The need for greater clarity and uniformity in current textile terminology is stressed. The formation of a British Textile Standards Association is recommended, to provide definitions for textile terms of ambiguous meaning, and specifications for fabric characteristics.

512. COTTON: FLUORESCENCE. By M. Dérivé. (*Revue Text.*, 33, 1935, p. 617. From *J. Text. Inst.*, xxvii., 2, 1936, A45.) Inclination of the sample at an angle of 45° to the light in the examination of fibrous materials in Wood's light is recommended, and observations of the fluorescence of samples of Sakel, American, Brazilian, Peruvian, African, Indian, and Egyptian cottons are discussed. The use of fluorescence effects for distinguishing between cotton and other textile fibres, and between new and used cotton materials, and the study of scouring and mercerising faults in Wood's light are also discussed, and tables showing the fluorescence and ammonia, urea and sodium sulphate contents of cotton wastes and second-hand fillings are reproduced from the paper by Moskowitz, Landes and Himmelfarb.

513. COTTON: EFFECTS OF MOISTURE AND HEAT. (*Revue Text.*, 33, 1935, p. 757. From *J. Text. Inst.*, xxvii., 4, 1936, A178.) The effects of moisture and heat on the drawing properties and twist of cotton fibres and threads are discussed, and the importance of the natural oil or gum present on raw cotton in fixing and steaming processes is pointed out. Details of the practice of sprinkling with water are given, together with moisture content figures for raw cottons of different origins.

514. COTTON: MOISTURE RELATIONS. By A. Bradley. (*Trans. Faraday Soc.*, 31, 1935, p. 1652. From *Summ. of Curr. Lit.*, xvi., 3, 1936, p. 66.) The author's adsorption equation $a = ap^{T/273x} (1 + \beta p^{T/273x})$ is tested on the data for several systems, including that of cotton and water vapour. The data of Orme Masson and Richards (1907) are fitted up to $p=0.598$ by the values $a=0.05883$, $\beta=-0.4465$, $x=2$, and in the other portion of the isotherm by $a=0.01389$, $\beta=-0.9208$, $x=4$.

515. FURTHER STUDIES ON THE EFFECT OF SUNLIGHT ON THE STRENGTH AND COLOUR OF COTTON FABRICS. By M. A. Grimes. (*Bull. No. 506, Texas Agr. Exp. Sta.*, 1935.) The changes in strength and colour of 35 cotton fabrics were measured after each 25 hours of exposure to sunlight until 500 hours of exposure had been reached. The fabrics studied were well-known brands, each in white, blue, green, yellow, lavender, and pink. All the fabrics lost strength as exposure increased, but not equally, the losses after 500 hours of exposure varying from

14 to 60 per cent. in the warp, and from 21 to 76 per cent. in the filling. Heavy fabrics of coarse yarns lost less than did light fabrics of fine yarns. The loss in strength of dyed fabrics varied with the dye or combinations of dyes used, but in general blues were less weakened than other colours. Among the fabrics identical in structure the white lost more strength than did any dyed fabrics except the pink, indicating that most dyes afford protection against tendering, or weakening, by sunlight. All white and coloured fabrics changed in colour during exposure. Colour changes were not dependent upon the colour, but upon the dye and depth of dyeing. Dark colours faded less than light colours. Guaranteed fabrics underwent less change than those not guaranteed, but "tub fast" fabrics were not light fast. Results of the study suggest that where light fastness is desirable, it is not impossible to attain, nor unreasonable to demand, a minimum fastness, in dyed fabrics, of 100 hours of exposure to sunlight before fading is perceptible.

[Cf. Abstr. 145, Vol. XI. of this Review.]

516. JAPANESE COTTON WASTES: PROCESSING. By J. H. Townson. (*Text. Mfr.*, 62, 1936, p. 6. From *Summ. of Curr. Lit.*, xvi., 6, 1936, p. 147.) A detailed description is given of the processing of baled Japanese thread wastes for the production of weft for cotton blankets. The bales are exported in a very hard condition, 560 lb. of waste occupying $34 \times 26 \times 22$ cub. ins.

517. "COTONIA" CLEANING MACHINE. (*Leips. Monats. Text. Ind.*, 1936; *Fachheft*, 1, p. 9. From *Summ. of Curr. Lit.*, xvi., 7, 1936, p. 176.) In cleaning cotton and cotton waste, the cotton is carried on a lattice, compressed by a roller, and then fed by a pair of feed rollers to a cylinder having saw-tooth clothing and rotating at 1300-1400 turns/min. The cotton is carried round by the cylinder and the impurities fall out. A steel foil shell fits round the lower part of the cylinder at a small distance from the points of the saw teeth, and a knife holds back knots and neps which fall into the shell whilst the web is carried along on the cylinder clothing. A fan directs a current of air tangentially on to the cylinder and directs the web on to a slowly rotating cage. Fine dust and small fragments of fibre are drawn into the cage and the cotton collects on the surface of the cage and is drawn off through a pair of rollers.

518. OIL-SPRAYING APPARATUS. By A. H. Milnes. (*Text. Mfr.*, 62, 1936, p. 46. From *Summ. of Curr. Lit.*, xvi., 7, 1936, p. 177.) Prior to carding and spinning, cotton, wool, jute and hemp fibres may be sprayed with water, oil, or an oil emulsion, in order to condition or soften the material, to minimise, through lubrication, fibre breakage in opening processes, and to prevent fly in carding by adhesive action. In spraying cotton, an emulsion of one part of oil to three parts of water is superior to water, and it is probably preferable to spray at the delivery of the finisher scutcher cages rather than, as is usual, at the hopper feeder. There are four main types of atomiser sprayers: (1) the suction method, in which the air under pressure draws up the water to the nozzle orifice; (2) the gravity feed method, in which the water is fed to the orifice by gravity, the air being under pressure; (3) the sealed tank method, in which the air under pressure is passed over the surface of the water in a sealed container, so that both water and air pass the nozzle orifice; (4) the pressure method, in which both air and water are under pressure. The principle of all these sprayers is the same, namely, that the air supplies energy to move the water, assisted by the energy, if any, of the water.

TRADE, PRICES, NEW USES.

519. LANCASHIRE'S COTTON INDUSTRY. By W. S. Ascoli. (*Text. Wkly.*, xvii., 420, 1936, p. 341, and subsequent numbers.) Discusses the possibilities of expansion of the export trade.

520. LIVERPOOL COTTON ASSOCIATION: AN ACTIVE YEAR. By A. C. Nickson. (*Man. Guar. Coml. Ann. Trade Review*, January, 1936, p. 59.) A very interesting account of the work of a year of particular activity. The most important matter was the introduction of the new futures contract for American and outside growths, in which trading began at the commencement of 1936. The question of the existing Sakellaridis contract also came up for consideration, but no suitable contract was evolved, although it was generally agreed that something must be done to improve the existing contract. The question of membership of the Association was also considered. The number of members was originally limited to 100, but it was decided to increase the number to a maximum of 200.

521. COTTON SUPPLIES AND PRICES. (*Text. Mercury Ann. Trade Rev.*, 14/2/36, p. 21. From *J. of Text. Inst.*, xxvii., 4, 1936, A194.) Statistics of the world's cotton crops are given and attention called to the advance of outside growths. The estimate for the 1935-36 season is 15,602,000 bales (500 lb.) for outside growths and 11,709,000 for American cotton. Another table records the weekly prices for American Middling, Egyptian E.G.F., Good No. 1 Oomras, 32's American twist, and 60's Egyptian twist for 1935.

522. PRICE-QUALITY RELATIONSHIPS IN FARMER'S COTTON MARKETS OF TEXAS. By W. E. Paulson and J. F. Hembree. (*Bull. No. 501*, Texas Agr. Exp. Station, 1934.) Growers are not sufficiently rewarded, under the system of marketing now in vogue in the farmers' cotton market, for producing the higher qualities, nor sufficiently discounted for producing the lower qualities. During the seasons 1926-27 to 1932-33 farmers received on an average 20 per cent. of the premiums for grades above Middling recognized in the "Basis-Middling" limits used by merchants in buying cotton from their representatives in the local markets; growers were assessed on the average 31 per cent. of the discounts for grades below Middling recognized in "Basis-Middling" limits. In the case of staple lengths, growers received on an average 6 per cent. of the premiums for staple lengths above $\frac{7}{8}$ inch prevailing in "Basis-Middling" limits; they were assessed on an average 10 per cent. of the discounts for staple lengths below $\frac{7}{8}$ inch obtaining in "Basis-Middling" limits.

In terms of premiums and discounts for quality without regard to price level, growers were underpaid on an average by \$3.50 a bale for Strict Middling $\frac{1}{8}$ inch cotton during the season 1930-31 and overpaid on an average by \$2.55 a bale for Strict Low Middling $\frac{7}{8}$ inch; on an average for the seven-year period growers were underpaid by about \$4.90 a bale for Strict Middling 1-inch cotton and overpaid by about \$7.15 a bale for Low Middling $\frac{1}{8}$ inch.

Before the grower with cotton of quality higher than the average can hope to sell his product on its merits, certain adjustments are necessary in the local market. Foremost among the things needed are: (1) official classification of cotton by an employee of the U.S. Dept. of Agriculture prior to sale by the grower; (2) expansion of the official market news service of the U.S. Dept. of Agriculture to include price quotations for cotton under "Basis-Middling" conditions, as well as in "even-running" lots; (3) fuller collection and wider dissemination of information relative to varieties of cotton being planted in the various soil areas, and their adaptability to such areas.

523. NEW USES FOR COTTON. (*Int. Cott. Bull.*, xiv., 54, 1936, p. 235.) The gas bag of the balloon used by Captains A. W. Stevens and O. A. Anderson of the U.S. Army Air Corps, in their record-breaking flight into the stratosphere last November, was composed of three cotton fabrics having a total area of about 12,000 square yards, or approximately 2½ acres. The outstanding feature of the materials was lightness, strength, and freedom from imperfections. Below are given the constructions and certain properties of the three cloths:

<i>Fabric.</i>	<i>Cotton.</i>	<i>Construction.</i>	<i>Weight Per Sq. Yd.</i>	<i>Thickness (In.)</i>	<i>Breaking Strength Per In.</i>
BA.30 ...	Pima	80 × 80	4	0.009	80
BB. ...	Egyptian	104 × 104	3	0.007	60
H.H. ...	Egyptian	130 × 138	2	0.005	40

To prevent diffusion of the gas, twenty coats of rubber were applied to the fabric. This treatment added about 0.002 inch to the thickness of the cloth, increased the weight per yard by some 2 to 3 oz. and raised the breaking strength. The bag was formed by cementing the rubberized fabric and rubber taping along the seams. For attaching the gondola to the balloon, 40 lines of flat linen webbing 1½ in. wide and ¼ inch thick were used instead of rope to prevent twisting.

524. COTTON ROADS IN THE UNITED STATES. (*Text. Rec.*, liii., 637, 1936, p. 68.) Three States—New Jersey, North Carolina, and South Carolina—have applied to the U.S. Bureau of Roads for allotments of cotton fabric membrane to be used in the construction of 140 miles of cotton reinforced bituminous surfaced roads this spring. According to the Cotton Textile Institute, New York, at least a dozen other States are expected to prepare similar applications to share in the \$1,300,000 recently set aside by the Dept. of Agriculture for a nation-wide demonstration of the practicability of cotton fabric in highway construction, and it is estimated that some 1,000 miles of cotton reinforced roads will be constructed during the year. The 140 miles of road in New Jersey and the two Carolinas will absorb approximately 1,650,000 square yards of cotton fabric, 74 inches and 82 inches wide. It is claimed that the fabric, which serves as a bond between road base and top surface, protects the road against surface cracks and other faults.

525. COTTON "RUNWAY" FOR AMERICAN AIRPORT. (*Int. Cott. Bull.*, xiv., 54, 1936, p. 233.) The American Cotton Textile Institute announce that specifications for construction of the Port Newark (N.J.) Airport include provision for the installation of the first cotton "runway." This runway, 200 feet wide and 700 feet long, will require more than 15,000 square yards of a specially designed mesh fabric to be used as a reinforcing membrane between a bitumuls-stabilized base and the asphalt top-surfacing.

MISCELLANEOUS.

526. REPORTS ON THE WORK OF AGRICULTURAL RESEARCH INSTITUTES AND ON CERTAIN OTHER AGRICULTURAL INVESTIGATIONS IN THE UNITED KINGDOM, 1933-34. (Min. of Agr. and Fisheries. London, 1936. Pubd. by H.M. Stat. Off. Price 5s. net.) The volume outlines the progress of agricultural research carried out with the aid of State funds during the academic year 1933-34 at Research Institutes and other centres in the United Kingdom. A numbered list of the papers published during the year by each Institute or research centre is appended to each report, and references to the numbers of these papers will be found in the text. A list of the names and addresses of Directors of Research Institutes and

persons in charge of investigations at other centres is given in the Appendix. An index is also included.

527. THE IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY. The Twenty-eighth Annual Report contains the report of the Governing Body for the year ended July 31, 1935, and an account of the work of the various departments of the College. The total number of students registered was 1,049, or 25 less than in 1933-34. On the results of research work done at the College 89 higher degrees of the University of London were awarded, and 121 higher diplomas of the Imperial College, a total of 210 compared with 209 in the preceding year. The number of B.Sc. degrees awarded to Imperial College students was 211, including 141 with Honours, compared with 178 and 116 respectively in 1933-34. Two hundred and five Associateships were awarded, compared with 176 for the preceding year. The grand total of distinctions for 1934-35 was 626, compared with 562 for 1933-34. In connection with the Appointments Board, of the total of 275 appointments secured, 133 were obtained through the efforts of the Board, and 142 without such assistance. Some 200 papers were published during the year, the titles of which are included in the report.

528. IMPERIAL COLLEGE OF TROPICAL AGRICULTURE. The Principal's Report for 1934-35 records that the work of the College in training students in tropical agriculture, and in various branches of research, was carried on satisfactorily throughout the year. Long-range research, as in the past, centred round the four main crops in Trinidad—sugar-cane, cacao, bananas, and citrus—and the work on these crops is described. The investigations carried out by the Departments of Agriculture, Botany, Chemistry and Soil Science, Economics, Entomology and Zoology, and Mycology and Bacteriology, are also described. The total number of students in residence was 44, or one less than last year. During the year 16 Associateships, 8 Diplomas, and 3 Certificates in Agriculture were awarded. Forty-four scientific papers were published, including those written for "Tropical Agriculture."

ADDENDUM.

529. THE GENETICAL CONCEPTION OF THE SPECIES. By S. C. Harland. (*Biol. Rev.*, xi., 1936, p. 83. From *Pl. Bre. Absts.*, vi., 3, 1936, p. 225.) After a review of other genetical work on species problems, the author describes and discusses his own work on *Gossypium* in relation to the genetical conception of the species.

It was found that all characters exhibiting simple monohybrid behaviour within the species exhibited complicated and often continuous blending in the F_2 of interspecific crosses, *hirsutum* and *barbadense* being the species on which most work has been done; the hypothesis was put forward that different species differed in the complex of modifying genes associated with the major genes, and that it was the segregation and recombination of these which were responsible for the blending type of inheritance. The truth of this hypothesis was demonstrated by the fact that by back-crossing the heterozygote repeatedly to one or the other parent species clear-cut monohybrid segregation could again be obtained. In this way it was possible to transfer genes from one species to another, demonstrating the existence of homologous loci in different species and also gaining a knowledge of the genetical architecture of the different species.

The distribution of the genes at sixteen loci is known in *hirsutum* and *barbadense*, and it appears that they are alike in seven recessive genes and one dominant. In respect of the other genes the commonest situation is that at a given locus there is a series of multiple allelomorphs, some of which characterize *hirsutum* and some *barbadense*. This situation may also exist with reference to the

recessives, and one dominant mentioned above, but this needs further investigation.

In a similar way the constitution of *purpurascens*, *tailense*, *tomentosum* and *Darwinii*, with respect to these major genes can be tabulated. It is found that *purpurascens* and *tailense* show no well marked differences from *hirsutum*, though it appears that they have their own special allelomorphs at certain loci. In *tomentosum*, endemic in the Hawaiian Islands, wider differences are found, and it is doubtful whether any of the dominant genes are identical with those of the other species, though identity of loci has been demonstrated for nineteen factors; two new genes, K^r (khaki lint) and H^r (hairy plant body) have been found which do not occur in any of the other species.

The existence of loci in Asiatic cottons, with $n=13$ chromosomes, homologous with loci in the New World cottons with $n=26$ chromosomes has also been demonstrated, the factor R , a member of a multiple allelomorph series in the former, proving to be also a member of a similar multiple allelomorph series in the latter, though here, again, the associated complex of modifiers was very different in the two groups and greatly affected the expression of the gene.

By the method of repeated back-crossing several dominant genes have been transferred from *barbadense* to *hirsutum*, and it has been found in general that their expression is diluted in the latter, apparently indicating that the presence of the dominant genes in *barbadense* is in some way connected with the presence of plus modifiers, the converse holding in *hirsutum*.

The behaviour of the crinkled dwarf mutant has thrown much light on the nature and function of modifier complexes. This recessive mutant has been recorded four times in *barbadense*, but never in *hirsutum*; by back-crosses it has been transferred to different varieties of *hirsutum*, and its behaviour there has been studied. In *barbadense* the heterozygote is normal, 3 : 1 segregation being obtained in the F_2 , and the same is true in *hirsutum* T 57. In interspecific crosses, however, whether normal $\times$ crinkled or crinkled $\times$ crinkled, a series of forms is obtained in the F_2 , and it is found that homozygous crinkled on some backgrounds is pseudo-normal and heterozygous crinkled on other backgrounds is phenotypically crinkled. Furthermore, by placing the normal allelomorphs of crinkled occurring in different forms on the respective backgrounds of *barbadense*, *hirsutum* T 57, and *hirsutum* T 9, it has been found that these three types are characterised by different normal allelomorphs, which can only be distinguished by their reaction to the different modifier complexes. The *barbadense* allelomorph is the strongest and shows complete dominance on all three backgrounds; the *hirsutum* T 57 shows complete dominance on its own background, nearly complete on T 9 and incomplete on *barbadense*; the *hirsutum* T 9 allelomorph exhibits incomplete dominance on its own crinkled background and also on *barbadense*. It is considered that *hirsutum* T 9 has had its modifier complex impaired by *barbadense* genes.

These results have a bearing on Fisher's theory of dominance and do not altogether support it, for complete dominance exists in a species where the mutant has never occurred, and it has also been shown that the main genes themselves differ in their potency quite apart from the effect of modifiers.

The occurrence of homologous characters throughout a genus or a series of related genera is a common phenomenon, which also occurs in *Gossypium*. It is now known that there are three ways in which such homologous characters as red and green plant body, yellow and cream pollen and so on can be built up—viz., by using different members of a multiple allelomorph series, together with a specific modifier complex, by using different members of a pair of duplicate genes in association with a specific modifier complex, or by accumulation of plus modifiers in the absence of the main gene (e.g., pseudo-normal mentioned above).

The existence of widely different methods of constructing homologous characters is of great interest in relation to species problems in general, though in this case it is partly due to polyploidy. In general it appears that the species of *Gossypium*, though possessing homologous loci, differ considerably in genetical architecture as a result of long separation. Apart from chromosome changes, however, there is no reason to suppose that any process but gene substitution and natural selection has taken place.

As a result of these differences floral abnormalities, for instance, are fairly frequent in interspecific crosses, but the fact that most combinations possess perfect flowers argues that the species possess either a common stock of genes or an assemblage of mutually replaceable ones.

PERSONAL NOTES

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are on the Fourth Floor of King's Buildings, Dean Stanley Street, Millbank, S.W. 1.

At the time of writing, the following officers are on leave in this country from cotton-growing countries:

Ceylon	...	...	...	...	...	Mr. J. C. Haigh.
"	...	...	...	...	...	Mr. M. Park.
"	...	...	...	...	...	Mr. R. E. Ponniah.
Fiji	...	...	...	...	...	Mr. H. W. Simmonds.
Gold Coast	...	...	...	...	...	Mr. J. D. Broatch.
"	"	...	...	...	...	Mr. E. L. Hay.
"	"	...	...	...	...	Mr. F. R. B. Mullan.
"	"	...	...	...	...	Mr. L. J. Packham.
"	"	...	...	...	...	Mr. A. W. Paterson.
"	"	...	...	...	...	Mr. C. L. Skidmore.
India	...	...	...	...	...	Mr. G. C. R. Coleridge.
"	...	...	...	...	...	Mr. J. H. Ritchie.
"	...	...	...	...	...	Professor W. Roberts.
"	...	...	...	...	...	Mr. H. R. Stewart.
"	...	...	...	...	...	Mr. J. Tinker.
Nigeria	...	...	...	...	...	Mr. F. E. Buckley.
"	...	...	...	...	...	Captain W. B. Dowson.

Nigeria ...	...	...	...	...	...	Mr. E. T. Holmes.
" ...	...	...	...	...	...	Mr. E. W. Leach.
" ...	...	...	...	...	...	Captain J. R. Mackie.
" ...	...	...	...	...	...	Mr. S. D. Ross.
" ...	...	...	...	...	...	Mr. D. H. Urquhart.
Nyasaland ...	...	...	...	...	...	Mr. E. Lawrence.
" ...	...	...	...	...	...	Mr. R. Leach.
Palestine ...	...	...	...	...	...	Mr. S. J. Gilbert.
Sierra Leone ...	...	...	...	...	...	Mr. F. C. Deighton.
" "	...	...	...	...	...	Dr. F. J. Martin.
Sudan ...	...	...	...	...	...	Mr. F. W. Andrews.
" ...	...	...	...	...	...	Mr. M. A. Bailey.
Tanganyika Territory...	...	...	...	...	...	Mr. E. Harrison.
" "	...	...	...	...	...	Mr. H. Marsland.
" "	...	...	...	...	...	Mr. H. H. Storey.
Uganda ...	...	...	...	...	...	Mr. J. Carmichael.
" ...	...	...	...	...	...	Mr. N. S. Haig.
" ...	...	...	...	...	...	Mr. E. F. Martin.
" ...	...	...	...	...	...	Mr. H. L. G. Milne.
" ...	...	...	...	...	...	Mr. G. T. Philpott.
" ...	...	...	...	...	...	Mr. E. A. Ruck.
West Indies: <i>Antigua</i> ...	...	...	...	...	...	Mr. F. H. S. Warneford.
" " <i>Barbados</i> ...	...	...	...	...	...	Dr. S. J. Saint.

Sir Geoffrey Evans, Principal of the Imperial College of Tropical Agriculture, Trinidad, and Controller of the Corporation's Research Station in that island, is on leave in this country.

The following officers of the Corporation's staff abroad are on leave, or will shortly be arriving in England:

Nigeria ...	...	...	...	...	...	Mr. A. E. Casement.
Nyasaland ...	...	...	...	...	...	Mr. S. T. Hoyle.
South Africa ...	...	...	...	...	...	Mr. O. V. S. Heath.
" "	...	...	...	...	...	Mr. F. R. Parnell.
Southern Rhodesia. ...	...	...	...	...	...	Mr. J. E. Peat.
Swaziland ...	...	...	...	...	...	Mr. J. V. Lochrie.
Trinidad ...	...	...	...	...	...	Dr. E. Phillis.

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PESTS AND DISEASES

SIR ALBERT HOWARD'S thought-stimulating paper in our last number will interest a wide circle, whether of specialists in economic biology or agriculturists and plant breeders. It may be permitted to one who saw the first beginnings of such work in the Empire, and who has had several of its professionals as colleagues, to make a few remarks.

Going out to Ceylon in 1896 as Director of the famous botanic gardens, and succeeding the well-known systematist Dr. Trimen, I found a splendid botanic garden with branches in various elevations and climates. The small vote of £3,000 a year only paid for a small amount of work, but that work was first-class. It consisted (apart from the upkeep of the gardens) of the working out and publication of the flora, a task nearly complete at the time of my arrival; of the introduction and acclimatization of all kinds of plants that might be useful or ornamental; of trying to get people to give these a trial upon a larger scale than was possible in the limited area at my disposal; and of giving advice upon horticultural or agricultural matters.

Trimen had already published three volumes of the flora, and the completion of the work was placed in the capable hands of Sir Joseph Hooker, who had completed the flora of British India. It was clear that the chief source of work was about to dry up, and at the same time it was equally clear that the Department possessed an organization that would render it of extreme value for other scientific botanical work, whether in pure science or in science applied to the problems of agriculture. Most people laughed at the idea that science could be of any use in the latter connection, and it is very greatly to the credit of Sir West Ridgeway, then Governor of Ceylon, that he had grasped such a possibility. Neglect of science had ceased, however, in such countries as Holland and others, and a magnificent research establishment was kept up at Buitenzorg in Java under the famous Dr. Treub. I studied its programme, and those of similar places, with a view of finding out what might best be done in Ceylon.

One thing was quite clear, that the scientific reputation of

Peradeniya must be kept up, and I did this by imitating Dr. Treub and making it a centre for pure (long range) research. Hitherto workers on such lines had mainly gone to Java, but during the next fifteen years about 80, including some very famous botanists, came to Ceylon. But it was also needful to make the place of direct aid to agriculturists in Ceylon, and I was still a little undecided as to what line to open first, other than the investigations in rubber tapping which I was myself carrying on with a view to getting the plant started as an agricultural product in Ceylon, all rubber then coming from wild trees. Suddenly, however, the question was decided from outside.

Rumours began to spread that there was a bad outbreak of disease (the cacao canker) among the plantations of cacao to the north of us. The experience of the famous coffee disease of twenty years before had shown that the agricultural community usually tried its best to prevent the news of such an event leaking out, probably because it tended to depress shares upon the market. So when at last I received a request for help from a cacao planter, I went down at once, expecting to find the disease widely distributed. And indeed this was the case, and it became immediately clear that one of the first reorganizations to be made was to set up a section to deal with troublesome diseases and pests.

We had in Ceylon at that time, but engaged in the actual work of tea planting, an entomologist who was already making a name for himself, Mr. E. E. Green, who some years ago was President of the Royal Entomological Society. Permission was obtained from Government to employ his services as official entomologist, though at first it was only in an honorary capacity. The cacao canker was actually a fungus disease, but Mr. Green came down to look at it with me, and after a few trials we recommended a simple and easy way of treatment that would at any rate largely reduce its incidence, and would probably prevent what at the moment appeared only too probable—a severe set-back to the cacao-growing industry. This treatment was simply to cut out and burn the cankered bark (which was fairly easy to recognize) until no further discoloration could be seen, and put a cheap antiseptic on the wound. It was taken up by the planters, who were seriously alarmed about their crop, and was very successful. It was easily operated, and was inexpensive—two points of great importance in the starting of what at that time was a new departure in agriculture. After this there was little difficulty in obtaining a permanent appointment for Mr. Green, who, so far as we are aware, was about the first, if not the very first, official entomologist in the tropical empire, and only preceded by Miss Ormerod in Britain

itself. Mr. J. B. Carruthers was soon afterwards appointed Mycologist, and similar appointments were being made about the same time in the West Indies under Sir Daniel Morris. It is from these early beginnings that the whole profession of "plant doctors" in the Empire has grown up.

This growth was in no small degree due to the early success of Mr. Green, who was himself an expert in the outdoor work of practical agriculture, so that he knew what could be done and what could not, and that especially from a financial point of view—for a treatment that is too costly will not be properly carried out. His recommendations were consequently practical, efficient, and inexpensive, all of them points which appealed very much to the practical agriculturists with whom we had to deal, men who at first were doubtful as to whether science could really be of any value in aiding them, and who were chary of allowing their attacks of disease or pest to become known. Mr. Carruthers followed the example of Mr. Green, and very soon they won the confidence of the planters, who quickly developed the habit of letting us know of any outbreak as soon as it appeared. Before many years had passed, there was little or no likelihood of concealment of a pest or disease until too late.

What has just been written is a good argument in favour of one of Sir Albert Howard's contentions, that the entomologist and the mycologist responsible for the treatment of diseases should have a personal knowledge of the actual plants with which they are concerned—their growth and structure (including the roots, which tend to be neglected), their ecological reactions to their environment, the operations employed in their cultivation, with the results to be expected, their labour cost, and anything else that is in any way concerned with the genetics, the growth, and the cultivation. If the specialist can have the control of an area upon which he can himself grow the crops with which he has to deal, so much the better.

What was written above is also an argument against following Sir Albert Howard too far (*cf.* p. 191, para. 2). In the case of annual crops like cotton or wheat, he is probably right, but one cannot easily scrap a perennial crop into which much capital has been put, like tea, cacao, or rubber, and start again. Treatment, such as that above instanced for cacao canker, may save the crop for the time being, and be less necessary in future by reason of improvement in cultivation and in other respects.

Looking at the matter from a general agricultural point of view, it is not wise to allow the specialist to become too much specialized—a direction to which there is always a tendency. Almost

unconsciously he comes to feel that he is there to treat the complaint as a phenomenon which has suddenly appeared, and to be less interested in the reasons for that appearance. Yet the essence of good treatment, as we are continually finding out more and more in human medicine, in economics, in politics, and in fact in everything, is to search for, and whenever possible to find, the root of the evil, and attack it there. There is always a reason for the appearance of a pest or disease; it does not appear casually without any encouragement, except perhaps in the case of a crop or a pest new to the district concerned. The man who has to find a remedy for it should fully understand the genetic history and the constitution of the plant, the way in which it has been treated, and what the result of such treatment is likely to be, so that he may be able, not only to treat the complaint itself, but to say how and why it has arisen, and thus be able to recommend agricultural or other measures that shall prevent its reappearance. Without such knowledge the treatment must be largely empirical, as was human medical treatment in days gone by, though it is becoming less so as time goes on. One's ordinary physician, who understands one's constitution, habits, weaknesses, etc., can usually treat any ordinary complaint at least as well as, if not better than, the specialist who may be called in, unless the latter has the benefit of the former's special and personal knowledge.

At the same time, if the specialists of a department possessed a general knowledge of agriculture and its problems, they would have a much better chance of appointment to the more important and better paid posts in the agricultural world.

No one can read Sir Albert Howard's paper without being struck by the commonsense of his contentions. It is almost impossible to live long in this world without realizing that the more the body is kept in good general health, and not strained by excess in any direction (so that no particular organ or group of organs is brought below par), the less is its liability to any disease. Nor can one observe the vegetation growing upon a spot which is in a state of untouched nature, like a moor, a forest, or a sandhill, and fail to observe its general health and its freedom from disease or pest. A moment's thought will show that if plants living thus, without the protection that is afforded to them when they are cultivated, were seriously liable to the attacks of pest or disease, they would not long survive in the locality. Their survival shows that they are not seriously liable, while that of the pest or disease (unless it be omnivorous) shows that they can provide enough of liability to prevent the dying out of the pest. It is fairly clear that complete

normality—general suitability to environment, including (what is sometimes lost sight of) that of the root to the soil, a fairly average climate for the locality in regard to sunshine, rainfall and its distribution, a suitable drainage, etc.—is usually accompanied by a general absence, or very slight incidence, of pests and disease.

But the cultivated plants with which we have to deal in agricultural work are not in a state of nature, and one may almost say that the aim of all those who have to grow or otherwise attend to them should be to bring them into a state as near to that of nature as possible, and to keep them in that state. If they have the best food, supplied in correct proportions; if the soil be of a type suited to the root growth and be kept in the state of tillage best adapted to that growth; if the climate be suitable, and be fairly average for the locality—in fact, if the plants be well suited to their position and be well treated in it—it is fairly clear that they will give the best return possible if they be free from attacks of disease or pest. But how is this to be ensured? Sir Albert Howard's contention is that if the breeder of the variety, and its cultivator, have done their work properly, there will be little or no need for the physician at all, and we have seen reason in nature to believe in the general truth of this contention. In nature the plant is not provided with conditions in all of which it is expected to grow, but the conditions are provided in great variety, and the plant grows where it can find those most suitable to it, and does not grow elsewhere. To expect a plant to do well anywhere is really a counsel of perfection, and we are gradually learning what conditions are impossible for certain plants. It will be a long time yet before we can do without the aid of the physician. Mere financial and political reasons will make it impossible to scrap a cultivation at short notice and try another place or another crop.

It is of interest to notice, and it confirms what we have already said, that many tropical peoples have devised a system of "cultivation" which gives to their plants a very considerable freedom from pest or disease, though it would be absurd to suggest that it was started with this end in view. In Ceylon and other tropical countries the natives often grow (one can hardly say cultivate) their economic plants mixed up in a miscellaneous way. For example, there may be jaks, coconut and toddy palms, oranges, shallocks, ginger, areca-nut, and many other things all growing at irregular intervals upon the same ground, with a turf of sorts between them which is seldom or never cultivated or manured. Yet the plants rarely show any serious attack of pest or disease, though on the other hand the yield is small as compared with what may be obtained by better cultivation.

In India and in many other countries (Africa, for example) a modification of this system is employed, and two or three plants only are cultivated together, cotton often being one of them.

Mixed cultivation has many likenesses to the condition of things in nature; it certainly helps to avoid disease, and brings with it many of the advantages of rotation of crops—a process which is a distinct aid to good cultivation, in that it uses different food-supplies, and different parts of the soil, in different seasons, instead of all in the same season, as in nature. Is the freedom from disease in nature due to the better distribution of the foods, or is it due to the absence of cultivation? Is liability a price that one must pay for the greater yields of good cultivation, or can it be averted, as Sir Albert Howard believes, by good cultivation and the best breeds of plants?

The original, natural homes of the plants now in cultivation were as a rule much smaller in extent than the regions where they are grown today, though there are a few exceptions, like cinnamon, which is still practically confined to Ceylon. There, it is of interest to note, it is (or was) but little troubled by disease or pest. But on the other hand, it may have a special power of resistance by virtue of its smell and of its leathery leaves. It would be of special interest to know exactly what has caused its failure elsewhere. In Rio de Janeiro we carried on some experiments upon the struggle for existence, cultivating certain plants in large flat boxes with limited space and soil, and following the life of each individual. As the seeds were sown much too densely, most of the plants died out, and this was almost always from attacks of disease, not directly from mere inanition. Their cultivation was wrongly carried on, as they were so densely crowded; was this the sole reason of their death?

It is rare for an attack of disease or pest to reduce plants in a state of nature to the miserable condition in which one may find cultivated plants, and in a state of nature the employment of a specialist in such matters would be a mere waste of money. Why, then, should it be so much needed with cultivated plants? What are the differences in the circumstances of the latter? They are not grown mixed, but in "pure stand"; but this is not unknown in nature, though, of course, it makes it easier for a pest to spread. The food supply is not being drawn upon by many different plants, each wanting different amounts; and the ground is kept in a state of tilth, and more or less free of weeds.

In the case of cotton, the plant is new to the flora of a great many regions in which it is now being cultivated, and has been suddenly

introduced there from some place far away. If, then, there happened to be, already at home and fully acclimatized in the place, a pest or disease that was already an enemy of the family *Malvaceæ*, to which cotton belongs, it might find cotton so attractive, and so suitable, that there might be a bad outbreak. Sir Albert Howard thinks that if the cotton were really suited to the neighbourhood, and were properly cultivated, this would not occur. But with a new crop, like cotton, for example, in South Africa, one can only find out by long experience—such as used to be learnt in the old botanic gardens, and then only partially—whether the crop is suited or not, and what is its best agricultural treatment. The chances are, therefore, that the crop will be apt to suffer severely from pests and diseases, and that fairly soon after its arrival in the country. This is more or less what did happen in South Africa with the jassid, which prevented cotton from being a success there, probably either because the varieties were unsuitable or because the plant was improperly cultivated.

Now take the case of the boll weevil in America. Here the cotton was already fully established and acclimatized, and probably (which is not saying much) as well cultivated as man knew how, except for the fact of continuous cultivation on the same land, without any rotation of crops, and with none too much manure. In this case it was the pest that came from abroad, and spread gradually over the whole area of cotton then cultivated in the southern United States. No efforts, whether in poisoning, in breeding, or in improved cultivation, have succeeded in shaking its hold, and it continues to destroy annually about a fifth or a sixth of the crop. This extraordinary expansion in numbers of an organism that is new to a country is familiar enough, as is witnessed by the cases of cacti or rabbits in Australia, of cardoons in Argentina, of nettles in Britain, of various diseases, hitherto unknown, among natives in newly discovered countries, to say nothing of diseases or other pests among plants. In the case of the boll weevil, which came from over the way, so to speak, one may assume that it would not have spread so rapidly had the southern U.S. not been so largely planted with an attractive food.

In the case of the jassid in South Africa, its menace has been almost completely countered by the breeding of the variety U4, whose leaves are more hairy than usual, while in the United States, where the pest was the invader, the same kind of attack upon it has not been found feasible, though it may at some future date prove to be so.

Nature works in a different way from man. She has unlimited

time at her disposal, and introduces new things into new countries by extremely slow and gradual steps, often on the way producing new species or varieties. If a plant in its slow journeyings come to a place where there is a pest or disease that at once attacks it at all seriously, it simply means that the plant cannot establish itself there. Or it may occur that a new variety is formed which is practically immune, and which is consequently able to settle. Man, however, is in a hurry, and wants to grow plant A at place B. If it is seriously liable to some pest or disease there, his soundest plan is to imitate nature, and form a new variety by local breeding and selection which is immune to that enemy. When it is the pest that is native, and the plant foreign, this can often be done with success, but when it is the other way about, the difficulty seems greater, and it is very hard to breed a suitable variety.

When one gives a general survey to the whole question, it is clear that Sir Albert Howard is probably quite correct when he calls pests and diseases the censors that indicate that something is wrong. The real difficulty, however, is to find out quickly what is wrong, and how to put it right. Merely to treat the outbreak with sprays, or by such methods, is empirical, and is only a palliative. We must find out why the attack came, and treat the matter at the root. On the other hand, the use of the palliatives is often dictated by financial considerations; one cannot afford to scrap a crop like tea or rubber, on which much capital has been sunk, and begin again, perhaps in a new place. Timely treatment may save the crop for the time being, and better treatment may prevent the reappearance of the trouble.

Probably the most frequent unfitness of a plant to its surroundings occurs in such cases as cotton in South Africa a few years ago. The local pests and diseases, particularly the jassid, had the advantage of being fully acclimatized, and able, in a land where the local members of the mallow family were also native and acclimatized, to find sufficient provender to survive. Cotton, a plant of the same family, new to the country, and planted in pure stand with as yet little knowledge of how best to treat it, provided a millennium for the jassid and other troubles, of which they took advantage until Mr. Parnell countered them by breeding U4, which was so immune to jassid and other pests or diseases that it was obviously a variety well suited to the country, as it grew well under the same agricultural treatment as its predecessors. This method of solution of the problem presented by an outbreak of some complaint will probably prove to be on the whole the best when it is the cotton that is the newcomer,

though probably less so when the reverse is the case, as with the boll weevil in the United States. Possibly some hitherto unfamiliar change in agricultural practice may prove necessary there. One can imagine, for example, watering with a very minute quantity of some substance that might cause such chemical change as to make the bolls unattractive. The introduction of organisms that prey upon the pest or disease may often prove useful. The use of direct empirical methods like spraying, etc., will be determined by the financial and other considerations that accompany each particular case, but as we improve in our knowledge of the best way in which to treat the plant, and so improve our agricultural methods, the need for such empirical treatment will steadily decrease, while breeding, on the other hand, will probably increase in importance. And it is also clear that our specialists in diseases should not be too specialized, but should also have a good general training in agricultural practice, and should themselves cultivate the crops with which they are concerned, and often use their trial grounds as demonstration plots to show how properly to treat the plants so as to avoid the attacks of pest or disease.

THE DEVELOPMENT OF COTTON CULTIVATION IN SIND, UNDER THE LLOYD BARRAGE AND CANAL SYSTEMS

BY

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THE Province of Sind is situated in the North-West region of India and comprises the lower valley and deltaic tract of the River Indus, which flows through the Province from north to south. It is bounded on the north by the Punjab, Baluchistan and the State of Bahawalpur, on the east by Jaisalmer and Jodhpur, two Indian States of Rajputana, on the south by the Rann of Cutch and the Arabian Sea, and on the west by the territories of Las Belas and Kalat States. The Indian State of Khairpur is situated in the north-east of the Province.

Formerly Sind was a portion of the Bombay Presidency for administrative purposes, but recently, as an outcome of the Government of India Act, 1935, it has been constituted into a separate Province. On April 1, 1936, His Excellency Sir Lancelot Graham, K.C.S.I., C.I.E., assumed the duties of the first Governor of the separated Province of Sind.

The total area of British Sind is 53,000 square miles, and according to the most recent census (1931), the population is approximately 9,300,000, of which about 73 per cent. are Mahommedans.

The country today is divided into eight districts. Hyderabad, Thar Parkar and Nawabshah, the three most important cotton-growing districts, are situated on the left bank of the River Indus; Larkana and Dadu districts, notable for their rice cultivation, are situated on the right bank. These five districts form the "Barrage" area and obtain their irrigation supply from the Lloyd Barrage and Canal Systems. The "non-Barrage" area consists of three districts, two in Upper Sind—i.e., Sukkur and the Upper Sind Frontier districts—and Karachi district in Lower Sind. These districts still rely upon the annual rise or "inundation" of the Indus for their water supply for crop production.

CLIMATE AND SOIL.—The climate is extremely hot in the summer

months and temperate to cold in the short winter season. In the interior of the Province, where the main cotton-growing tracts are situated, the average hot weather temperature is 95° F. although it frequently rises as high as 115° F. and occasionally to 120° F. During the cold weather season from November to March, the average temperature is 60° F., and frosts are common during the nights. In the coastal regions, including the capital city and port of Karachi, the climate is much more equable.

Sind is a country of extremely low rainfall. It lies just outside the track of both the monsoons upon which the bulk of the Indian Peninsula depends for its rainfall. The average annual precipitation of rain in Sind is 6 to 8 inches although, in certain years, sudden and excessive rainfall is experienced over short periods.

The soil is alluvial and very varied in its chemical and physical characters throughout the Province. As a result of successive deposition and erosion by the Indus, the proportions of sand and clay vary considerably within even the smallest areas. In general, there is a deficiency of organic matter. One notable feature is the presence of *kalar* or salt lands throughout the Province. The injurious salts consist largely of chloride and sulphate of sodium. These saline soils exist either as barren stretches extending over thousands of acres and covered with surface salt incrustations, or as patches of varying size, from a few feet to many yards in diameter, scattered here and there among cultivated lands. In the main cotton-growing tracts the soil consists of alternating layers of clay, loam and fine sand, and is comparatively rich in lime, potash and phosphoric acid.

THE INDIAN COTTON COMMITTEE (1917) AND SIND.—In 1917 the Government of India appointed the Indian Cotton Committee to examine the work done in various provinces in the establishment and extension of long-stapled cotton, and to submit recommendations for the improvement and development of cotton growing and marketing in India, with special reference to long-stapled varieties.

In their Report, issued in 1919, the Committee devoted a separate chapter to Sind. They described the efforts previously made to establish and extend the cultivation of Egyptian and American cottons in the Province, and stated that the unsatisfactory character of the irrigation supply was the main reason for the failure of such efforts. At the same time, the Committee were so impressed with the potentialities of Sind for the production of long-stapled cottons, given a satisfactory irrigation supply, that their Report contains the following passage:

" Provided a perennial supply of water can be assured, we hold the view that there is no other part of India which offers such hopeful prospects of the successful cultivation of long-stapled cotton."

Recent developments since the opening of the Lloyd Barrage and Canal Systems have fully justified this opinion.

Among the recommendations of the Committee with regard to Sind were included the separation of the Agricultural Department from that of the Bombay Presidency and the appointment of an Economic Botanist for the Province. Both these proposals have been put into effect. It is interesting to note that, in suggesting a " careful survey of the subsoil table " to be undertaken in the Barrage areas, and in advocating that " the question of the prevention of malaria should be investigated," the Committee anticipated two of the major problems which will have to be solved in the Lloyd Barrage tracts.

THE INDIAN CENTRAL COTTON COMMITTEE (1921) AND SIND.—The recommendations of the Indian Cotton Committee led to the establishment of the Indian Central Cotton Committee in March, 1921. It is now a permanently incorporated body, and as a result of the passing of the Cotton Cess Act in 1923, is provided with funds for the purpose of the improvement and development of cotton in India. The Committee have always taken great interest in the development of cotton cultivation in Sind, and in recent years have granted considerable sums of money for research work and seed multiplication and distribution schemes in the Province. Funds have also been provided for the appointment of a Cotton Technological Assistant on the staff of the Agricultural Research Station, Sakrand, who will be engaged on the scientific examination and testing of fibres of improved strains of cotton evolved by the botanical staff at the Station.

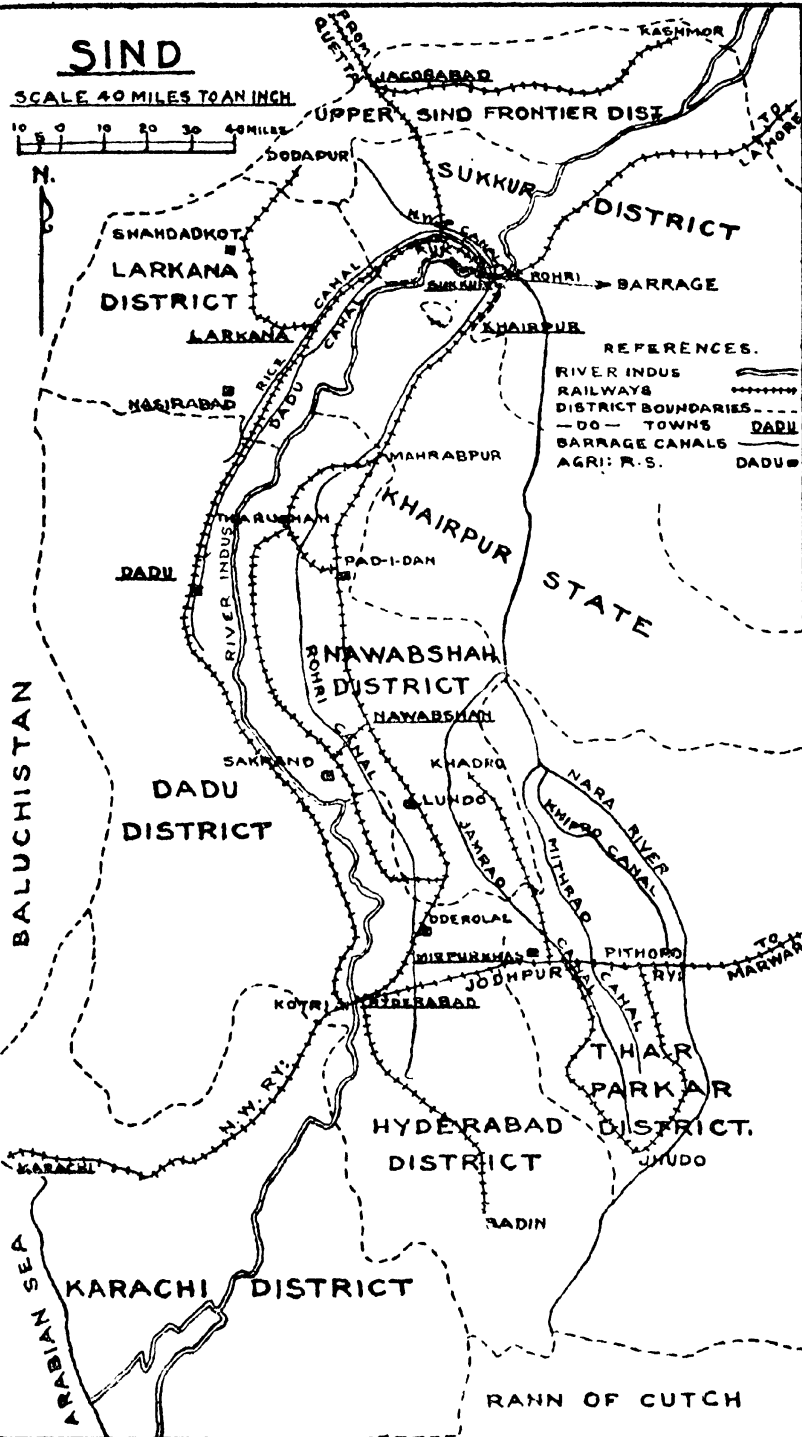
THE LLOYD BARRAGE AND CANAL SYSTEMS.—The Lloyd Barrage and Canals, which were opened on January 13, 1932, by His Excellency Lord Willingdon, then Viceroy of India, constitute an irrigation project of outstanding magnitude and importance. The total cost of construction was approximately fifteen million pounds sterling, and the area under irrigation command in British Sind amounts to 7,046,000 acres, of which 5,013,000 acres will be cultivated annually on attainment of the full development of the project. Prior to the construction of the barrage and canals, the irrigated area in Sind was approximately 1,850,000 acres, so that the increase amounts to 3,163,000 acres.

SIND

SCALE 40 MILES TO AN INCH

10 0 10 20 30 40 MILES

N.



The Barrage itself is a huge river regulator consisting of 66 spans of 60 feet each with an over-all length of 4,715 feet. It stretches across the Indus at the Sukkur gorge in North Sind and presents a magnificent appearance of stability and grace. Each of the spans or openings is equipped with electrically operated steel gates. On the down-stream side of the structure a road bridge is incorporated in the design, joining one bank of the river with the other.

The Canal Systems take off immediately above the Barrage on both banks of the Indus. The left bank canals are four in number—viz., the Eastern Nara, Rohri, Khairpur Feeder East and Khairpur Feeder West. The two first-named are the most important canals in Sind from the point of view of cotton cultivation. The Eastern Nara, 226 miles long, supplies the bulk of the irrigation water to the cotton-growing tracts of East Sind in the Thar Parkar district, and the Rohri Canal, 208 miles long, irrigates the districts of Nawabshah and, in part, Hyderabad. More than 95 per cent. of the cotton cultivation in Sind is situated on the command of these two canals and their numerous minors and distributories.

On the right bank three canals supply irrigation water to the fertile districts of Larkana and Dadu. Of these, the Rice Canal, 82 miles long, is mainly intended for irrigation of the rice areas in Central Sind and flows only during the hot weather season. The Dadu Canal, 131 miles long, and the North Western Canal, 36 miles long, are perennial canals, and the rapidly increasing area under cotton cultivation on the right bank tract is situated within their command.

EXPANSION OF COTTON CULTIVATION UNDER THE LLOYD BARRAGE AND CANAL SYSTEMS IN SIND.—Probably the most outstanding feature of agricultural development in Sind since the opening of the Lloyd Barrage and Canal Systems in January, 1932, has been the rapid expansion of cotton cultivation. During the ten-year period prior to the establishment of perennial irrigation under the Barrage, the average annual area under cotton was 320,880 acres and the average annual production 95,960 bales of 400 lb. The figures given on page 271 show the increase in area and production in the Province since 1932; the average figures for the previous ten years are given for comparison.

It will be seen that the acreage under cotton, *deshi* and American combined, has increased by 150 per cent. in 1935-36 in comparison with the average annual acreage during the decade preceding the opening of the Barrage and Canal Systems.

Turning to the production figures, the increase in acreage has

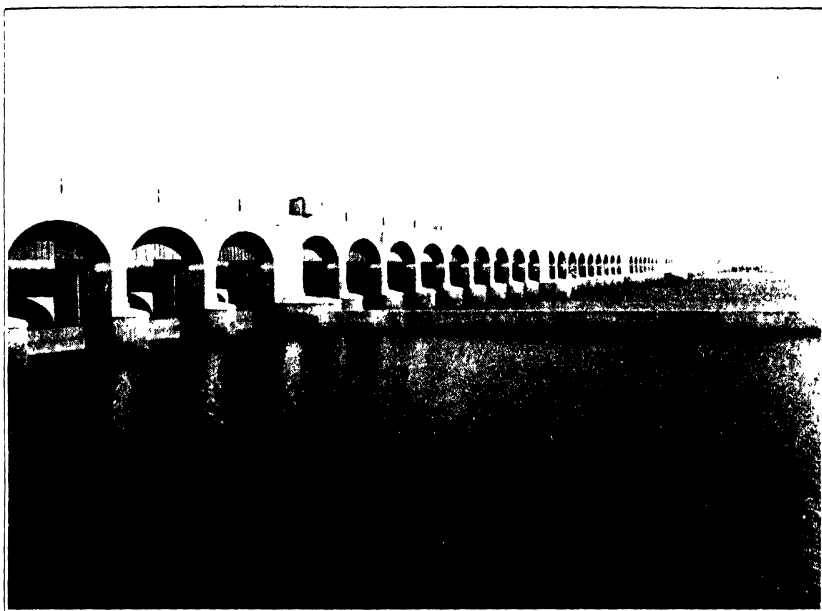


FIG. 1. THE LLOYD BARRAGE, SUKKUR. (UPSTREAM VIEW.)

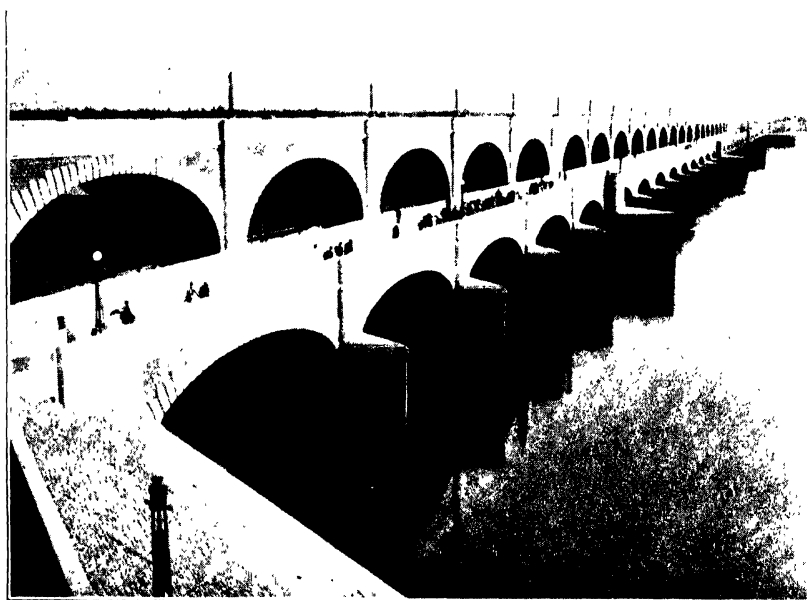


FIG. 2.--THE LLOYD BARRAGE, SUKKUR. (DOWNSTREAM VIEW.)



FIG. 3.—SIND "DESHI" COTTON—SIND N.R. GROWN ON RECLAIMED "KOLAR" LAND AT THE AGRICULTURAL RESEARCH STATION, SAKRAND.



FIG. 4.—SIND SEA ISLAND COTTON AT THE AGRICULTURAL RESEARCH STATION, SAKRAND.

DEVELOPMENT OF COTTON CULTIVATION IN SIND 271

been accompanied by an increase in the average yield of cotton per acre. The average outturn of lint in the decennial period prior to the opening of the Barrage was approximately 120 lb. per acre; during the past two seasons this yield has increased to 160 lb. lint per acre. This is undoubtedly due to the assured and perennial supply of irrigation water, the extension of the cultivation of improved and higher yielding varieties of cotton, and the introduction of better methods of land preparation and tillage.

<i>Year.</i>	<i>Area under Cotton (Acres).</i>	<i>Production of Cotton (Bales of 400 Lb.).</i>
1922-32 average of 10 years	320,880	95,960
1932-33	342,860	113,580
1933-34	520,986	169,210
1934-35	622,710	250,960
1935-36	804,170	323,020

There has been a striking increase in the area under medium and long-stapled cottons—*i.e.*, Sind-American varieties—since the advent of perennial irrigation under the Barrage. During the pre-barrage decade—*i.e.*, 1922-32—the area under American cotton in Sind averaged 25,640 acres, but during the past four years, 1932-36, the average acreage was 199,415 acres, and in the current season, 1935-36, approximately half the cotton area in the Province has been cultivated with American cotton.

Prior to the opening of the Barrage, variations in the area planted to American cotton in Sind depended upon the earliness or lateness of the Indus inundation, and on the premium offered by buyers for American cotton over *deshi* types. The first factor has now been removed with the establishment of perennial irrigation, and it remains to be seen to what extent comparative prices will affect the proportions of American to *deshi* cotton cultivation in the future development of cotton growing in the Barrage areas.

VARIETIES OF COTTON GROWN IN SIND.—Three classes of cotton are now being cultivated in the Barrage areas. These are (a) Sind *deshi*, (b) Sind-American and (c) imported Egyptian and Sea Island types. During the past season—*i.e.*, 1935-36—the areas under each of these groups of cottons were (a) 423,800 acres, (b) 380,300 acres and (c) 2,500 acres. The Botanical Section of the Agricultural Department in Sind has evolved improved strains by botanical selection of all these cottons, and their cultivation is being rapidly extended through the agency of departmental seed multiplication and distribution schemes.

respectively (*Gossypium barbadense*, Linn.). They are both cottons of very high quality, possessing a staple length of $1\frac{3}{8}$ to $1\frac{1}{4}$ inches and a ginning percentage of approximately 30. The extension of these "quality" cottons was commenced in 1934 when 150 acres were grown. In 1935 the area increased to 2,500 acres, and it is anticipated that about 15,000 acres will be cultivated in 1936. These cottons require better and more thorough cultivation than Sind-American or Sind N.R. (*deshi*) and should only be grown on rich, loamy soils. They are somewhat susceptible to seasonal climatic variations and to white ant attack in the early stages of growth, and, as a result, the yields of kapas are generally lower than those obtained from the hardier *deshi* and American varieties. They mature late and require to be sown as early as possible—i.e., in March and early April. The Sind Sea Island variety is hardier and appears to be better suited to conditions normally prevailing than the Sind Boss III variety. At present their cultivation is confined to Thar Parkar district.

COTTON PESTS AND DISEASES.—The cotton crops of the Barrage area have many insect enemies, and suffer from mycological and pathogenic infections which reduce plant vigour and cause considerable losses in outturn to the cultivators. A Crop Pest Section will shortly be established at the Agricultural Research Station, Sakrand. The most effective and economical insurance against loss from pests and diseases, however, will be found in a general improvement in crop management and soil tillage in the Barrage areas.

The most serious pests of cotton in the Province are jassid, termites or white ants, and spotted bollworm. Minor injury is caused by pink bollworm, the dusky cotton bug, lucerne caterpillar, the black-headed cricket, and white fly.

Among diseases, root-rot is the most common and persistent. Certain forms of wilt also appear, but so far are of minor economic importance. Jassid attack is associated with the development of "red leaf" in American cottons grown in Sind, and this condition is under investigation by the Physiological Section of the Agricultural Research Station, Sakrand.

GINNING AND MARKETING OF COTTON IN SIND.—There are no established and organized cotton markets, or "mandis," in the Province. Practically all the crop is sold in the villages and delivered to the buyers, in most instances the ginning factory owners, by the sellers. The growers are handicapped by ignorance of the prevailing rates in recognized cotton markets, by numerous "levies" or deductions made at the time of sale, and by the use of false weights

and measures. Attempts are being made by the Sind Cotton Committee to organize controlled markets at suitable centres, and in addition the possibility of establishing co-operative sale societies is under examination.

Prior to the opening of the Lloyd Barrage there were 37 ginning and pressing factories in the Province; at the present time there are 69 factories. Recently the Bombay Legislative Council passed an Amendment to the Cotton Ginning and Pressing Factories Act, 1925, providing for the licensing of all ginning and pressing factories, and for penalties against the malpractices of watering, false packing, or mixing of superior and inferior types of cotton. This Act is being applied to Sind with effect from September 1, 1936.

CONCLUSION.—What of the future? There appears to be little doubt that the extension of cotton cultivation in Sind will reach a million acres within the next few years, and that a total production of half a million bales of 400 lb. can be anticipated. Parities, premiums and prices must necessarily have a large influence in deciding the proportions of different types of cotton to be grown in Sind in years to come. Subject to such influences, the policy of the Agricultural Department with regard to cotton development is to concentrate on the extension of the cotton area under medium long-stapled ($\frac{3}{8}$ to $1\frac{1}{8}$ inch) varieties of cotton—i.e., Sind-American types—for the cultivation of which conditions in the Province are now eminently favourable. At the same time it is desirable to restrict, as far as possible, the production of the Sind *deshi* type of short-stapled cotton to 250,000 to 275,000 bales per annum as trade opinion considers that the demand is not likely to exceed this quantity and further increase would result in a glut in the restricted market for such cotton and in reduced prices to the growers. With regard to high-quality cottons—e.g., Sea Island and Egyptian—the Agricultural Department intend to encourage their cultivation in limited areas where conditions of soil and climate are suitable for their economic production.

In short, it is recognized that every effort must be made to encourage the cultivation of medium long-stapled cottons as the demand for such types by Indian mills is considerably in excess of present supplies produced in India, and any exportable surplus should find a ready market among spinners in other countries. Along with such a major trend of development it is necessary that the production of extremely short-stapled *deshi* cottons on the one hand and of high-quality exotic cottons on the other, for both of which purposes portions of the cotton-growing areas of Sind are

extremely favourable, should be developed to the full economic limit in the interest of the cotton growers of the Province.

In addition, every possible measure will be taken to raise the standard of cotton cultivation, to improve marketing conditions in the districts, to encourage the "community" system of cotton growing in selected areas, and to enhance the reputation of long-stapled cotton from Sind by checking malpractices and avoiding mixing with inferior types in field or in factory.

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THE EARLY DEVELOPMENT OF THE COTTON FIBRE

BY

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INTRODUCTION.—The development of the cotton hair is obviously a subject of considerable economic importance, and it is not surprising therefore that it has received increasing attention during recent years. Nevertheless, considerable discrepancy and confusion appear to exist in the interpretation of results. It seemed possible that a detailed cytological study of diverse material would yield some explanation of these discrepancies. For this purpose, material of Old and New World varieties of cotton obtained from India and Egypt was compared with cotton grown under glass in England.

Over fifty years ago, Bowman (1882) first discussed the formation of cotton hairs, concluding that they originated "in the second layer of cells beneath the cuticle of the seed." Many years later, Balls (1915) published an outline account of the development of all tissues of the cotton seed after fertilization. He found that the fibres begin to grow out from the epidermal cells of the ovule on the day that the flower opens, and that "there does not appear to be any further growth of epidermal cells into lint hairs after this first day, in spite of accepted statements to the contrary." Later (1919) he suggested that "possibly irregularities in length may arise from distribution of the normal simultaneous 'sprouting' of these cells over several days."

Turner (1929) contested this view, pointing out that on Balls' conception the number of hairs per seed must remain constant, and that the number of fibres per unit area of seed surface must decrease as the seed increases in volume. He suggested that the differentiation of hairs continues for some time after flowering. Gulati (1930) found that there is a sevenfold increase in the number of hairs in the first five days after flowering. This continued differentiation of hairs must be resultant upon continued mitotic divisions in the epidermal layers of the outer integument. Gulati claimed that mitosis occurs in these cells up to the tenth day after flowering. Singh (1931) made certain cytological observations and supported the view that the number of hairs increases during the life history of the ovule. Farr (1933)

observed mitosis in the epidermis up to the twelfth day after flowering. It is unfortunate that none of these cytological observations are supported by adequate photomicrographs of mitosis in the epidermis after the first few days, for from the photographs published by Barritt (1932) it would seem that division in the epidermis must have ceased long before even the seventh day after flowering. Ayyar and Ayyangar (1933) consider that the epidermal cells remain in a young growing condition for some time after flowering, stating that "we did not detect (in sections of Cambodia cotton ovules) actual mitosis in the epidermal cells beyond the second day after flower opening, but the nucleus was quite prominent in them till they were twenty days old." These authors also revert to the suggested subepidermal origin of the fibres.

It will be shown that great variation occurs in the development of the tissues of different seeds within a single boll and that different parts of a single seed are often differently developed. Thus it will be found possible to reconcile several of the contradictory statements outlined above.

MATERIAL.—One dozen plants of the variety Sakel were grown in a chamber of a glasshouse at Rothamsted Experimental Station in the summer of 1933. Seed from 1931 plants was obtained from Professor R. H. Stoughton. It was sown on February 15 and flowering commenced towards the end of May. Cotton had been grown in this same glasshouse for several seasons, so that information as to the best conditions was available. It was of course not possible to obtain the normal growing conditions of the cotton plant in tropical and sub-tropical regions. The light intensity in this country is very much lower, but Balls has shown that the too great light intensity experienced in Egypt retards growth. In England, the maximum intensity is probably about the optimum for growth, and it is during the dull periods that growth is retarded. Over the two months of June and July when all fixing was done, the average maximum day temperature was 39.5° C. and the average minimum was 21.4° C. The glasshouse chamber faced westwards and was in direct sunlight during the afternoon, so that the highest temperatures were attained about 3 to 4 p.m., the lowest being experienced about 3 to 4 a.m. Possibly the temperatures are lower than the optimum, but their retarding effect seems to be counterbalanced by other factors—the relatively long day experienced in this country in summer and the fact that the greater degree of humidity of the atmosphere of a glasshouse prevents wilting which may occur in the field. For the purposes of this paper it was essential that the flowers should develop

normally after fertilization. The time required after pollination for the boll to ripen affords a criterion of the normality of seed development. The bolls of these plants ripened 50 days after the flowers opened, the normal time of ripening varying from 40 to 60 days (Balls, 1915).

For comparison fixed material was obtained from Indore in Central India and also from Egypt. The material from Indore consisted of a New World type (Indore No. 1, a selection from Cambodia, of the *Gossypium hirsutum* type) and of an Asiatic type (Malvi, a selection from the local cotton of Indore. According to Gammie it is *G. neglectum* var. *malvensis*, whilst Harland classified it as *G. arboreum* L. var. *Nanking*). Samples of Maarad cotton were obtained from Egypt. Unless special mention is made the general description which will follow can be regarded as applicable to all the varieties examined.

METHODS.—On the day each flower opened it was labelled with a tab bearing the date and an appropriate number. In a few cases flowers were cross-pollinated, but usually they were allowed to become self-pollinated, pollination occurring naturally within a few hours of the opening of the flower.

A number of trials were made to find a suitable fixative. Among those tried were Carnoy's, Flemming's medium with or without acetic acid, Champy's and Helly's fluids and a chrome-acetic solution. Allen's modification of Bouin's fluid (B-15) was found to give excellent fixation in the early stages of seed development. Satisfactory fixation in the later stages is exceedingly difficult to obtain; the results yielded by the latter fixative were better than any given by other solutions. Much of the material grown at Rothamsted and all of that obtained from India and Egypt was therefore fixed in Allen's Bouin.

In England the material was fixed within one hour of noon (*i.e.*, between 11 a.m. and 1 p.m. Greenwich Mean Time), when maximum cell division is generally supposed to occur in this climate. The Indian material was fixed about 10 to 11 a.m. and that from Egypt between 9 a.m. and noon or 3 and 5 p.m. Bolls up to seven days old were cut into quadrants before fixing; after seven days, the seeds were dissected out before fixing. The fixative was warmed to 38° C. and an exhaust pump was always used. The material was left in the fixative for 4 to 6 hours. It was then passed rapidly through graded alcohols to 70 per cent. alcohol saturated with lithium carbonate. This solution was poured off and renewed at intervals until all the picric acid was washed out from the seeds. (Material from India and Egypt travelled in this solution.) Dehydration was then

completed with alcohol, the material was cleared in cedarwood oil and was embedded in paraffin wax of melting-point 52° or 58° C. according to the age and consequent hardness of the seeds. Sections were cut at 6 to 15μ .

A variety of stains were used. The iodine-gentian-violet method with or without a counterstain gave excellent results.

THE EPIDERMIS OF THE RESTING OVULE.—In the early part of the day on which the flower opens and pollen is transferred to the stigma, although occasional mitoses may be found, relatively little nuclear activity is observed in the outer epidermis of the outer integument of the ovule. This layer now consists essentially of closely packed cuboidal cells, radially elongated and each containing a large nucleus and richly staining cytoplasm (Fig. 1). Occasional cells bulge slightly to the exterior. The latter are already differentiated and will give rise to the first formed hairs without undergoing any further division. A few stomata are already differentiated (Fig. 2).

DIFFERENTIATION OF THE EPIDERMIS OF THE SEED COAT.—After pollination, the epidermis enters a phase of great activity. The undifferentiated cells divide, and certain of the daughter cells may develop into hairs or stomata. The other daughter cells divide repeatedly until all in turn are differentiated as lint hairs, as fuzz hairs, as stomata, or in such a way as to become coloured and thickened to form the protective epidermis of the mature seed.

Twenty-four hours after pollination the primordial hair cells distinguishable on the previous day have elongated radially to several times their original size (Fig. 3). As each cell elongates, the nucleus passes outwards so that it remains always about the centre of the cell. A few stomata are also differentiated on the first day; these and the young hairs are usually confined to the chalazal end of the seed. In the case of the Maarad cotton occasional seeds show hairs developing first at the micropylar end. The undifferentiated epidermal cells are in a state of very active division. The pollen tube reaches the embryo sac and fertilization occurs between one and two days after pollination (Fig. 5).

Singh (1931) stated that in bolls "forty-eight hours old almost all the epidermal cells have been found to be involved in the formation of fibres." This is true only of certain areas of the seed surface. At the chalazal end (Figs. 4 and 5) a very large proportion of the cells are developing into hairs, but towards the micropylar end the vast majority of the cells are usually undifferentiated at this time. As the hairs at the chalazal end are so closely packed it is obvious

that to produce the spaced hairs of the mature seed the few epidermal cells remaining amongst them must divide without the daughter cells always giving rise to further hairs.

The undifferentiated cells near the micropyle continue to divide rapidly. Actual counts were not made, but the general impression given by the preparations is to the effect that the number of mitoses reaches a peak about the second day after pollination or very soon after fertilization.

As the cells become differentiated into hairs or stomata, they obviously lose their power of division, and as more and more cells are differentiated, the number in mitosis at one time must decrease. At the third day, mitosis is still of quite frequent occurrence; on the fourth and fifth days, groups of meristematic epidermal cells (Fig. 7), as well as isolated dividing cells amongst long hairs (Fig. 6), are found in every seed. Hairs of various lengths occur in every section (Figs. 10 to 14) and stomata are well developed, especially towards the chalazal end. About this time certain areas of the epidermis are seen to have lost all power of division. The undifferentiated cells increase in volume, the nucleus remaining small and entering a resting condition. The cell vacuole becomes filled with the golden coloured cytochrome, and no cell in which cytochrome has developed is ever seen to divide.

Young hairs now begin to arise from the cells at the micropylar end of the seed and a few are formed also between the now much elongated hair cells towards the chalazal end. When they are about two days old, cytochrome is formed in a number of these, suggesting that many of the later formed fibres go to constitute the "fuzz." This is indicated also by their position: a tuft of fuzz hairs is usually present around the micropyle of the mature seed, and patches of fuzz hair occur also amongst the longer lint hairs towards the chalazal end. However, these later formed hairs are not all of the fuzz type. Lint and fuzz hairs are eventually found intermingled in those areas where no hairs are developed until several days after pollination. The diameter of these younger lint hairs seems to be slightly greater than that of the earlier formed fibres.

About six days after pollination, mitosis becomes increasingly difficult to locate in the epidermis. The latest dates after flowering at which it was observed are:

Sakel	...	...	...	...	Up to 10 days (Fig. 17).
Indore No. 1.	...	...	...	...	Up to 9 days.
Malvi	...	...	...	...	Up to 8 days (Fig. 10).
Maarad	...	...	...	...	Up to 9 days (Fig 16).

It is probable that mitoses do occur at still later dates. Divisions were not actually observed later, although uncoloured cells with large nuclei apparently still capable of division were found up to twelve days. By the twelfth day, except in these rare instances, all the epidermal cells are filled with cytochrome, as are also the fuzz hairs, only the lint hairs and the stomata remaining colourless. In occasional seeds this condition is reached by the seventh day, and frequently it is attained by the tenth day after flowering.

The intermingling of fully differentiated and meristematic cells that occurs in the epidermis of the cotton seed is most unusual. In the case of cambium and of the primary meristems, the cells remain quite undifferentiated until all in the immediate neighbourhood have ceased to divide.

VARIABILITY.—Previous writers have tended to stress the latest date on which they were able to observe mitosis. Very little significance should be attached to the exact time of cessation of all mitosis. This date is difficult or almost impossible to determine, and slight variations in conditions of growth may bring about differences in the rapidity of cell division. It is the variability in the growth of the fibres that should be emphasised. The foregoing description has shown that there is great variation in the development of different regions of the seed coat. Generally development is earlier towards the chalazal end of the seed (Figs. 5 and 14). This is shown not only in the epidermis but also in the internal tissues such as the palisade layer. The results described are in harmony with those of Koshal and Ahmad (1932), who found considerable differences in the physical properties of the fibres from different parts of the seed coat. They found the mean fibre length for the fibres at the base of the seed to be significantly greater than for fibres at the apex of the seed. That the basal fibres should be longer than the apical ones is in accordance with the fact that the basal ones are several days older than the apical, and that the mean fibre weight per unit length and the mean fibre strength should be greater for the apical fibres is compatible with the slightly greater diameter of the apical fibres.

Great variation also exists from seed to seed within the same boll. This was realized by Bailey and has led to the custom of selecting always the second seed from the base when sampling. It is also well exemplified by two photographs (Figs. 19 and 20) taken from two seeds of a single boll which were fixed, embedded and sectioned together and mounted on the same slide.

The amount of variation occurring from cell to cell of a single

seed and from seed to seed within a single boll is greater than the differences in development between varieties or even between Old and New World types of cotton. Obviously from an economic standpoint this variation is most undesirable, but its existence cannot be too greatly stressed. Failure to realize this variability, whilst drawing conclusions and basing hypotheses on the cursory examination of hastily prepared sections of a few seeds, has led to infinite confusion. The sectioning of a whole seed is a long and tedious process, but unless this is done it is impossible to determine whether cell division is complete, as whilst some areas are fully differentiated, others may remain meristematic. Even if whole seeds are sectioned mitoses may still be missed owing to the material having been fixed at an unfavourable period of the day,* although with experience cells still capable of division can usually be recognized. Special emphasis is laid on this variability, for not only has it led to confusion in the interpretation of cytological preparations, but such differences in the early development of the fibres cannot fail to affect the uniformity of the mature lint.

THE NUCLEUS OF THE PRIMORDIAL HAIR CELL.—Ayyar and Ayyangar (1932) noticed that the nuclei of the primordial lint hairs increase in size and that several small nucleoli appear; the latter fuse to form a single nucleolus. Barritt (1933) has pointed out that in the normal course of mitosis the nucleolus disappears during the prophase. At the telophase one or more nucleoli arise *de novo*. If several such nucleoli appear they may later fuse to form one body; this proved to be the case in cotton, and is not confined to the primordial hair cells. After each mitotic division several small nucleoli arise in each daughter cell. If the daughter cell is to give rise to a hair the nucleus increases in size, and the nucleoli fuse into one large spherical body which later often contains a crystal. If the daughter cell remains undifferentiated, these small nucleoli tend to fuse together, but a new mitotic division may be commenced before fusion occurs. In the case of daughter cells which have ceased to divide, and have assumed the characters of mature epidermal cells, the nucleoli generally fuse together into one body.

THE HAIR BASE.—Barritt (1929) has claimed that the portion of the hair embedded in the epidermis does not grow at all, and as

* In this connection it is interesting to note that many more cells were actually seen in the processes of cytokinesis in the material grown in England and in Egypt than were found in the two types sent from India. As the development of all varieties appeared to be as nearly parallel as is possible in such inconstant material, presumably the times of day selected for fixing in England and in Egypt were about the times of maximum division, but the time of fixation in India was not so fortunately chosen.

the neighbouring cells increase in size the hair base becomes crushed. On this observation he based his theory of fibre nutrition from the "boll-sap." Farr (1931) has denied the existence of the constricted hair base, stating that the apparent flattening is due to the plane in which the section is cut. The writer finds that for four or five days the bases of the hair cells do increase in size, keeping pace with the diameter of the fibre (Fig. 13). After this there appears to be no further increase and the bases may become constricted by pressure from the neighbouring epidermal cells which are increasing in size and in number. That the constriction is real can be determined either by focussing or by examination of adjacent sections. If the constriction were merely due to the plane of section, then the full width of the hair base should be so revealed, but such was not found to be the case.

The material grown in England was the only fresh material available which could be examined for "boll-sap." No liquid was found in the boll cavity. The question would bear further examination as the function of the stomata (Fig. 15) on the seed coat remains obscure.

STOMATA AND THE FUZZ HAIRS.—Ayyar and Ayyangar (1933) reverted to the theory of Bowman (1882) that the hairs are of subepidermal origin, making the naive suggestion that one of the subepidermal cells opposite a stoma "enlarges centrifugally and gradually finds its way out between the guard cells." These hairs are thought to be fuzz hairs, and in this way the constriction of the hair base is accounted for. Now, in the young seed all the tissues including the epidermis, hairs and stomata are colourless. As the seed ripens, the epidermal cells and the fuzz hairs become filled with cytochrome, but the guard cells of the stomata remain always colourless and their contents are unaffected by all the more usual dyes. If then a hair were to grow through the stomatal cavity we should expect to see a colourless cell on each side of the hair. This is not shown in Ayyar and Ayyangar's photographs where all the epidermal cells are densely coloured. Nor could it be observed in any sections or epidermal strippings from the mature seed (Fig. 21).

SUMMARY.—The development of the cotton fibres from primordial cells in the epidermis is described. Pollination stimulates cell division in the epidermal layer. Mitosis continues in the epidermis and young hairs are differentiated for a considerable period after flowering. The number of epidermal cells in active division seems to reach a peak at about the second day, but mitosis occurs to a diminishing extent until at least ten days after flowering.

The discrepancies in the results of previous workers appear to be due to an unexpected variation in the rate of development and differentiation in different cells of the same seeds, and in different seeds within the same boll.

ACKNOWLEDGMENTS.—I must express my gratitude to Mr. J. B. Hutchinson and to Mr. Bholanath of the Institute of Plant Industry, Indore, Central India, and to Dr. M. A. Fikry of the Royal Society of Agriculture, Cairo, Egypt, who so kindly fixed and sent material to me. I am also indebted to Mr. Barritt, of Rothamsted Experimental Station, for his great interest which has resulted in many helpful discussions. My thanks are due also to Miss M. M. Browne, in whose care the plants were grown at Rothamsted.

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EXPLANATION OF PLATES.

All photomicrographs were taken with a Leitz "Makam" camera. A Leitz "Monla" lamp, suitably screened with a Wratten "M" colour filter, was used as the source of illumination.

- FIG. 1.—Sakel. Day of pollination. The epidermis of the seed shows occasional cells in mitosis. 900 $\times$.
- FIG. 2.—Sakel. Day of pollination. Some stomata are already differentiated. 900 $\times$.
- FIG. 3.—Sakel. One day. Mitosis occurs in the epidermis and young hairs are differentiated. 900 $\times$.
- FIG. 4.—Sakel. Two days. Towards the chalazal end of the seed, a very large proportion of the epidermal cells are differentiated as hairs. 140 $\times$.
- FIG. 5.—Sakel. Two days. Longitudinal sections of the seeds show young hairs developing around the chalazal end. Very few hairs are seen towards the micropylar end. The pollen tube has reached the embryo sac. 30 $\times$.
- FIG. 6.—Sakel. Four days. Mitosis occurs in the epidermal cells between the hair bases. 900 $\times$.
- FIG. 7.—Sakel. Five days. Portions of the epidermis remain meristematic. 900 $\times$.
- FIG. 8.—Maarad. Seven days. Mitosis continues in the epidermis. 900 $\times$.
- FIG. 9.—Indore No. 1. Seven days. Mitosis still continues in the epidermal cells between the hair bases which are becoming constricted. 900 $\times$.
- FIG. 10.—Malvi. Eight days. An area of the epidermis near the micropyle which has remained in a meristematic condition. Young hairs are being differentiated. Sections of older hairs are also seen in the background. 900 $\times$.
- FIG. 11.—Sakel. Seven days. Very young fibres are growing amongst older ones. 140 $\times$.
- FIG. 12.—Maarad. Seven days. Hairs one or two days old are growing amongst older fibres. 140 $\times$.
- FIG. 13.—Maarad. Seven days. Constricted hair bases are seen between the epidermal cells. 140 $\times$.
- FIG. 14.—Sakel. Eight days. Longitudinal section of a seed shows long hairs and short hairs projecting from the epidermis and also a region of the epidermis which has not yet given rise to hairs. 20 $\times$.
- FIG. 15.—Maarad. Eight days. Section through the epidermis shows a stoma and a hair base. 900 $\times$.
- FIG. 16.—Maarad. Nine days. A region of the epidermis still remains meristematic. 900 $\times$.
- FIG. 17.—Sakel. Ten days. Mitosis may still occur in the epidermis. 900 $\times$.
- FIG. 18.—Sakel. Nine days. Mitosis occurs in the epidermis. Sections of long hairs are also seen. 450 $\times$.
- FIGS. 19 and 20.—Sakel. Ten days. These two sections were made from two different seeds from the same boll. In one the epidermis is meristematic; in the other, mitosis has long ceased. 450 $\times$.
- FIG. 21.—Sakel. Fourteen days. The hair base, constricted between the epidermal cells, projects into the subepidermal layer. 900 $\times$.

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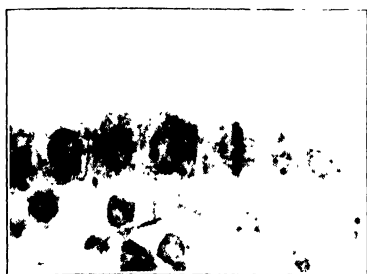


FIG. 1.

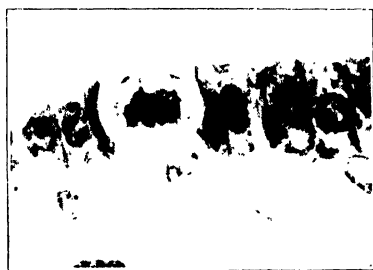


FIG. 2.

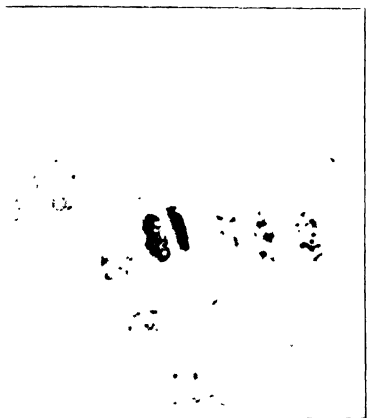


FIG. 3.

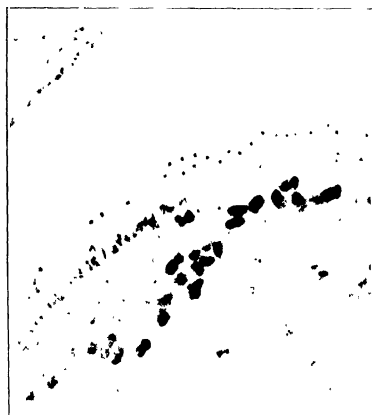


FIG. 4.



FIG. 5.

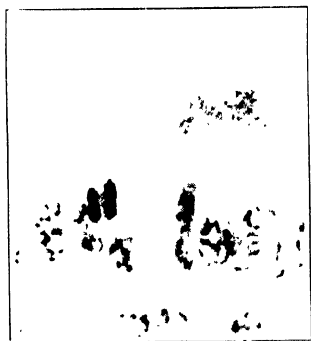


FIG. 6.

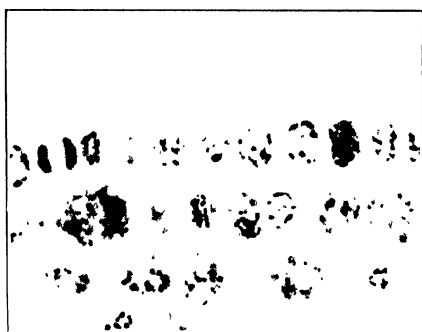


FIG. 7.

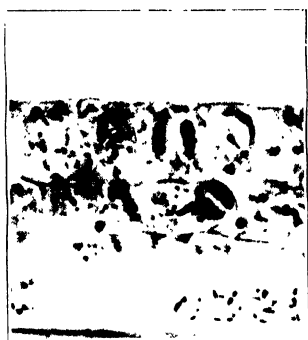


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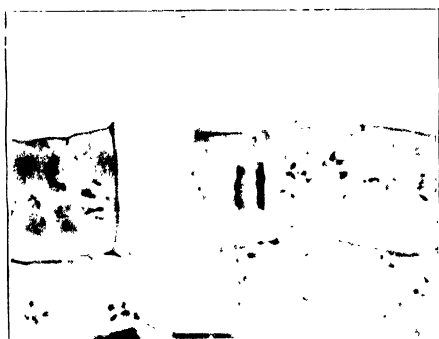


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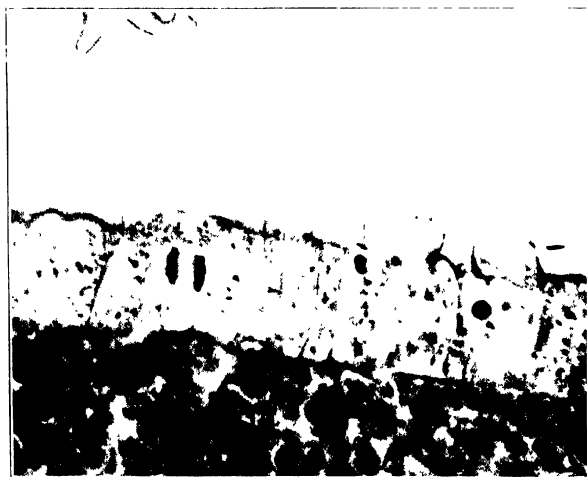


FIG. 10.



FIG. 11.

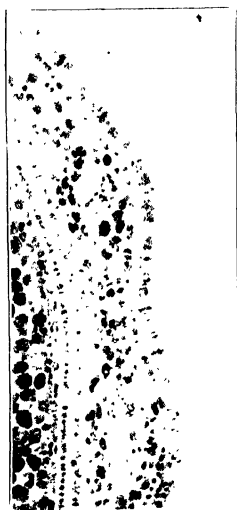


FIG. 12.



FIG. 13.

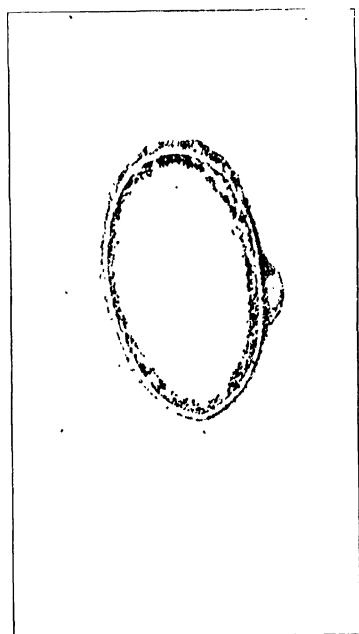


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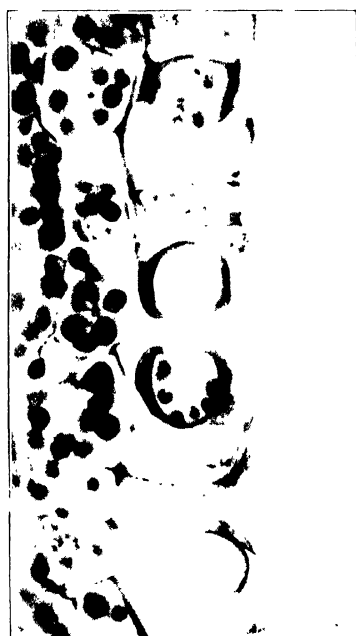


FIG. 15.



FIG. 16.

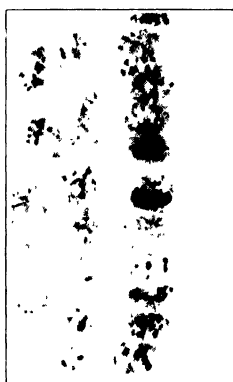


FIG. 17.

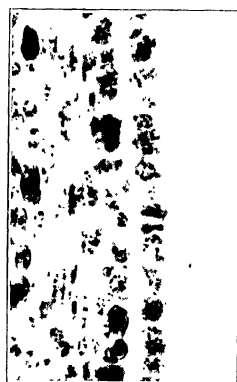


FIG. 18.

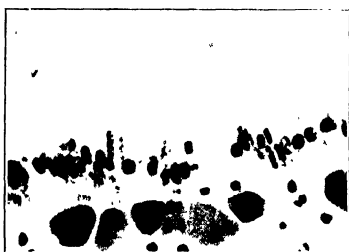


FIG. 19.



FIG. 20.

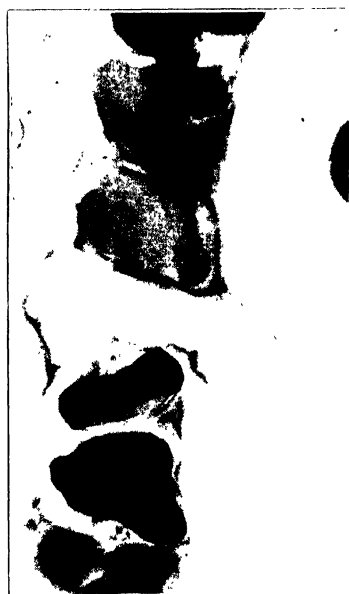


FIG. 21.

THE EFFECT OF LEAF CURL DISEASE ON THE YIELD OF THE COTTON PLANT

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INTRODUCTORY.—Leaf Curl disease on cotton was first described from Nigeria¹ in 1926, though its symptoms had been noticed on a few scattered Sakel plants in the Gezira area of the Anglo-Egyptian Sudan from the season 1923-24 onwards. Once established, the disease spread rapidly in the cotton of the Gezira, and in 1932-33 possibly 70 per cent. of the total crop was infected.

The disease is caused by a virus, which has been shown by Golding² in Nigeria, and Kirkpatrick³ in the Sudan to be transmitted by an Aleurodid. The symptoms in the Sudan have been described by Kirkpatrick,³ and more fully by Massey and Andrews.⁴ A very severe attack causes complete sterility of the growing parts of the plant, but doubt had been expressed as to whether, in the milder form in which the main bulk of the crop is infected, the disease does really cause much loss of crop.

Massey and Andrews⁴ attempted to estimate the effect of the disease on the yield of the cotton plant. That work was of necessity of a preliminary nature and is open to various objections which are indicated in the paper.

It was felt that the only satisfactory method of estimating the effect of the disease on the yield of the plant was by the comparison of healthy and infected plants of the same sowing date and growing either in the same hole or in very close proximity to each other.

In cotton sown at the normal date—i.e., about the beginning of August—the difficulty often arises that the healthy plant of a selected pair later becomes infected while in active growth. It was, therefore, decided that the experiment should be conducted on late sown cotton, when the rate of infection of the plants was falling rapidly.

The method described is the result of the collaboration of the author and Mr. A. R. Lambert of the Plant Observation Section. The work of the experiment and the presentation of the results are, however, the sole work of the author.

DETAILS OF THE EXPERIMENT.—A small plot of Sakel cotton was sown on October 15, 1932. The plants were thinned once to five plants per hole, but no further cultural operations were carried out on them. Sakel seed of the same kind as that sown in the main Gezira area was used for this experiment. The crop obtained was in consequence not pure, and as many comparable pairs as possible were chosen in order to reduce any error due to the impurity of the seed.

The growing period of cotton plants sown at this date coincides with the time when the rate of infection with Leaf Curl disease (as judged by the presence of its symptoms) is decreasing rapidly, and comparative pairs of healthy and infected plants can be obtained with relative ease.

SELECTION OF COMPARABLE PAIRS OF PLANTS.—The selection was carried out on January 14, 1933, the following conditions being considered necessary before a particular pair was chosen: (1) both plants must be in the same hole; (2) the plant infected with Leaf Curl must show symptoms on its lowest leaf and on the bracts of all its fruits; (3) the control plant must not show any symptoms on any part of the plant; (4) the plants to be compared must be the two tallest in the hole (*i.e.*, unless an early infected Leaf Curl plant and a control plant were the two tallest plants in the hole, no plants were to be selected), the remaining plants in the hole must be cut out; (5) no restrictions to be placed on the position of the holes, except that if the plants of a particular hole were growing in a place where normal growth would be unlikely, they must not be chosen. By this method of selection, 88 comparable pairs were obtained.

ESTIMATION OF YIELD.—It was originally decided that the seed cotton from these pairs was to be picked and weighed, and any difference between the control and the infected plants calculated from the weights obtained. Owing, however, to the late maturing of cotton plants sown on this date, and also to the non-commensurable effect of boll worm on late sown cotton, it was decided to adopt the following method for measuring the effect of Leaf Curl on the plant.

On March 27, 1933, the plants were cut out at ground level, and the following observations made: (1) fresh weight of each plant; (2) total number of green bolls on each plant; (3) total weight of green bolls on each plant; (4) total number of open bolls on each plant (*i.e.*, bolls ready for picking); (5) total weight of seed cotton on each plant; (6) total number of flowers and buds on each plant; (7) total weight of flowers and buds on each plant; (8) weight of stems and leaves on each plant (by calculation).

By this date—i.e., March 27, 1933—most of the plants had commenced their second growth period, and it was noticed that on practically all of the healthy members of the comparable pairs Leaf Curl symptoms were appearing on the new growth of leaves, and on the flower bud bracts. The infection of the new growth, however, had occurred very late indeed, and was not likely to affect the bolls already matured.

RESULT OF THE INVESTIGATIONS.—The results obtained are indicated in the following tables:

TABLE I.
TOTAL NUMBER OF GREEN BOLLS, ETC.

<i>Details.</i>	<i>On total of 88 Infected Plants.</i>	<i>On total of 88 Healthy Plants.</i>	<i>Percentage Decrease on Healthy Plants.</i>	<i>Difference of Means.</i>
Green Bolls	558	1087	48.6	6.0
Open Bolls	243	473	48.6	2.6
Buds and flowers	157	164	4.3	0.08

ANALYSIS OF RESULTS OF TABLE I.

Green Bolls: $t=6.1$ (for $P=0.01$, $t=2.6$).

Result: *Highly significant.*

Open Bolls: $t=5.2$ (for $P=0.01$, $t=2.6$).

Result: *Highly significant.*

Buds and flowers: $t=0.16$ (i.e., P is between 0.8 and 0.9).

Result: *Not significant.*

TABLE II.
WEIGHTS IN GMS.

<i>Details.</i>	<i>Healthy Plants.</i>	<i>Infected Plants.</i>
Average fresh weight per plant	236.3	126.8
Unit weight of green bolls	6.2	5.8
Average weight of seed cotton per unit open boll	1.47	1.37

ANALYSIS OF RESULTS OF TABLE II.

Fresh weight: $t=31.8$ (for $P=0.01$, $t=2.6$).

Result: *Highly significant.*

Unit weight of green bolls: $t=3.07$ (for $P=0.01$, $t=2.6$).

Result: *Significant.*

Weight of seed cotton per unit open boll: $t=1.47$ (for $P=0.01$ and 0.05 $t=2.6$ and 0.674).

Result for $P=0.01$: *Not significant.*

TABLE III.

	<i>Healthy Plants.</i>	<i>Infected Plants.</i>
Fresh weight of stems and leaves per plant ...	140.9 gm.	102.8 gm.

ANALYSIS OF RESULTS OF TABLE III.

Mean difference=38.1 gm.: $t=4.3$ (for $P=0.01$, $t=2.6$).

Result: *Highly significant.*

TABLE IV.

	<i>Healthy Plants.</i>	<i>Infected Plants.</i>
Percentage of green bolls of total bolls ...	69.6	69.5
Percentage of open bolls of total bolls ...	60.3	30.4

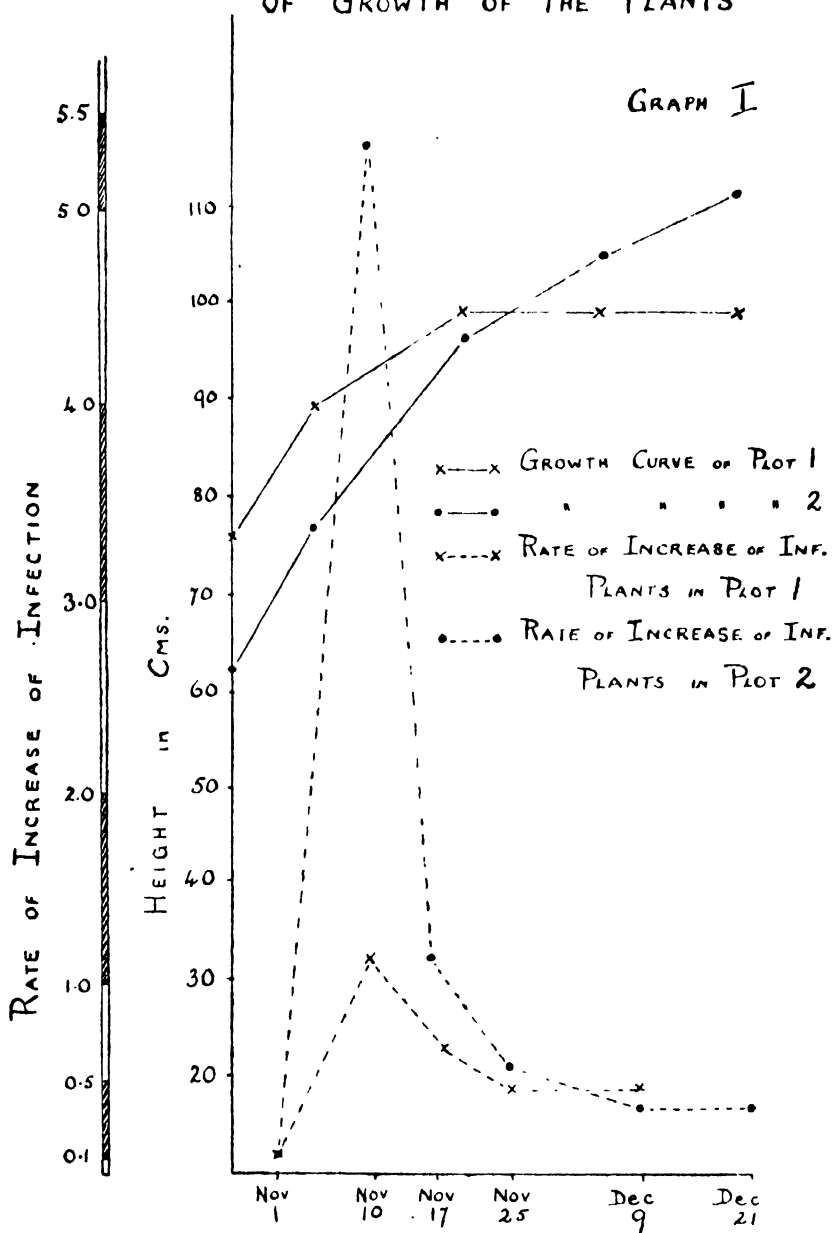
DISCUSSION.—The disease appears to have caused a significant reduction in the fresh weight of the infected plants as well as a considerable decrease in their fruit production.

The fact that the total buds and flowers (after subtraction of the open and green bolls) in both diseased and healthy plants do not differ significantly is a result of the fact (as has been pointed out previously) that the *new* growth of the healthy plants was showing symptoms of the disease—thus when dealing with buds and flowers, which are a result of this new growth, we have in our comparable pairs two sets of infected plants and consequently could not expect to get a difference in the total number of buds and flowers.

There seems to be a definite suggestion that the full effects of the disease were only being shown in the green bolls of the plants, and that the disease did not arrive early enough to cause any significant decrease (for a value of $P=0.01$) in the unit weight of seed cotton in the open bolls, which presumably were the first bolls to be formed. There is, however, a definite tendency towards a reduction in the weight of seed cotton in a unit open boll, since the decrease is significant when $P=0.05$.

It might be argued that the disease had attacked the badly growing plants, and that the difference in boll number and fresh weight was not due to it, but to difference in the natural growth of the plants. All previous work with Leaf Curl, however, has shown quite clearly that the symptoms of the disease invariably appear first on the better

ILLUSTRATING RELATION OF RATE OF INCREASE
OF LEAF CURL INFECTION TO THE RATE
OF GROWTH OF THE PLANTS



growing plants, since active growth is a necessary condition for the expression of these symptoms. This is illustrated in Graph I. Cotton was sown in two adjacent plots, plot 1 containing ordinary Gezira soil which consists principally of a heavy clay, and plot 2 containing soil from the Gash Delta, a light soil; it will be seen that the higher growth rate in plot 2 is associated with a greater increase of infection.

It is impossible to say from the results of this experiment if the disease causes sterility of the fruiting branches or shedding of the already formed flower buds, but since it causes both a reduction in the total number of bolls and also in unit weight of the green bolls it seems probable that if shedding does occur, it does so at a very early stage of the flower bud growth.

Owing to the fact that the cotton plants of this experiment were sown at the "out of season" date of October 15, the percentage loss of cotton due to the disease cannot be taken as representing the reduction occurring in plants sown at the normal time—*i.e.*, about the beginning of August. At the time of disease attack, the cotton of normal sowing date would have formed a considerable proportion of its bolls, and in consequence the loss of crop would presumably be much less. This has been demonstrated by the results obtained when the yield from large areas of cotton during a season of severe general infection has been compared with the yield obtained from a season of light infection. Recent research on loss of crop due to causes other than visible disease—*e.g.*, unaccountable shedding of already formed buds and bolls—has indicated that a delicate and varying relationship exists each season between the bolls that a plant produces and the number it can retain to full maturity, and it has been suggested that the high percentage loss sustained by the diseased plants in this experiment may possibly be due to the upsetting of this balance by Leaf Curl disease, with a consequent shedding of some bolls which the plants might have retained in spite of the disease, had they been growing under different conditions—*e.g.*, on a better soil.

SUMMARY.—(a) Leaf Curl disease has caused a highly significant reduction in the number of green and open bolls; (b) the total buds and flowers in both diseased and healthy plants do not differ significantly; (c) the fresh weights of the healthy plants are very significantly greater than those of the infected plants; (d) the unit weight of the green bolls on the healthy plants is significantly greater than that of the green bolls of the infected plants; (e) for a value of $P=0.01$, the weight of seed cotton for unit open boll of the healthy

plant is not significantly greater than that of the infected plants, but for $P=0.05$, the open bolls of the diseased plants show a significant decrease from the weight of seed cotton of unit healthy boll; (f) the weight of the stems and leaves of the healthy plants is very significantly greater than that of the infected plants; (g) the percentage of green and open bolls of the total bolls is the same in both cases for both the healthy and diseased plants.

ACKNOWLEDGMENTS.—I have to acknowledge my indebtedness to Mr. R. E. Massey, Government Botanist, Sudan Government, and Head of the Plant Pathological Staff, for help in this work, and to Mr. M. A. Bailey, Director of the Agricultural Research Service, under whose direction these researches were carried out.

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WORKING CATTLE IN THE ANGLO-EGYPTIAN SUDAN

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A FEW years ago there appeared in this Review an article by Mr. H. C. Duckering on working cattle in Nyasaland, and more recently a paper by Mr. G. Browne on the use of cattle in Northern Nigeria, and the following brief description of the method recommended for the management and working of cattle in the Anglo-Egyptian Sudan may also be of interest.

The Sudan has vast areas of cultivable land which are now uncropped, largely owing to the lack of population. Except in the northern Sudan cattle are very little used for cultural operations. They are cheap and abundant, and if properly utilized the present cropped area could be considerably extended even with the existing scant population.

The cattle are a Zebu type, and weigh from 7 to 10 cwt. when mature. They are very easily trained and make good workers when well fed and looked after. Both bulls and cows (Figs. 1 and 2) can be used, but naturally the former are more suitable. If worked too young growth is checked, and no heavy work should be expected before the animals are mature.

MANAGEMENT.

Working Hours Recommended.—Sunrise until 11 a.m. and 3 p.m. until sunset, with one day per week rest. During the heat of the day working animals require food, rest, and shade, otherwise they rapidly lose condition and are more susceptible to disease. Compounds or tethering grounds should be periodically moved and located on land that will eventually be cropped. The custom of tethering animals by tying a rope round the base of the horns is satisfactory, but it should be so tied that it does not slip tight and cut into the flesh. Wind breaks are most important, especially during cold periods of the rain and the winter seasons.



FIG. 1. BULLS.

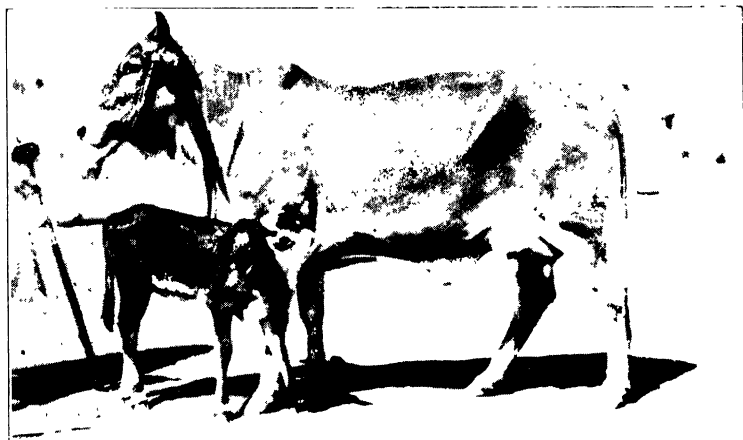


FIG. 2. COW AND CALF.



FIG. 3.—CONTROL ROPE.

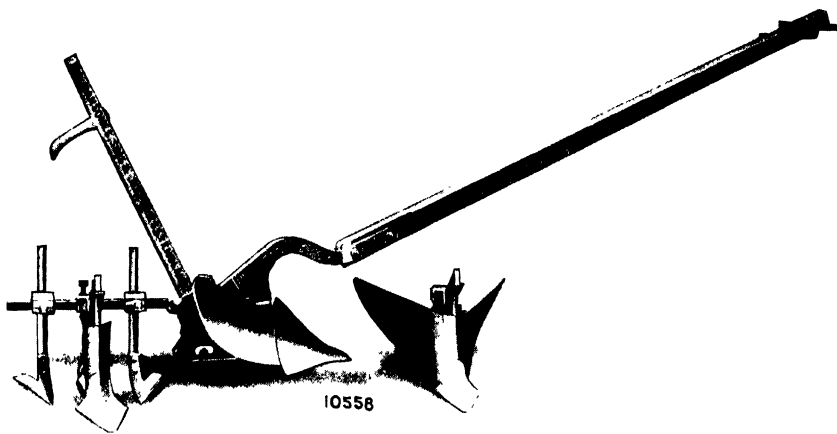


FIG. 4. E. T. PLOUGH.

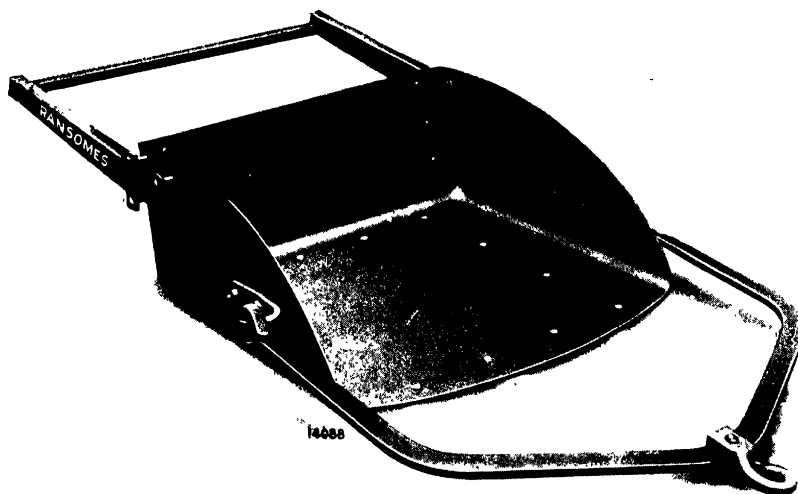


FIG. 5. SOIL SCOOP.

Feeding.—Three feeds a day should be sufficient. Water should be given before each feed. The following daily ration is recommended :

6 lb. concentrates—sesame cake, cotton cake, maize, millet, beans (*Vicia faba*), lubia seed (*Dolichos lablab*).

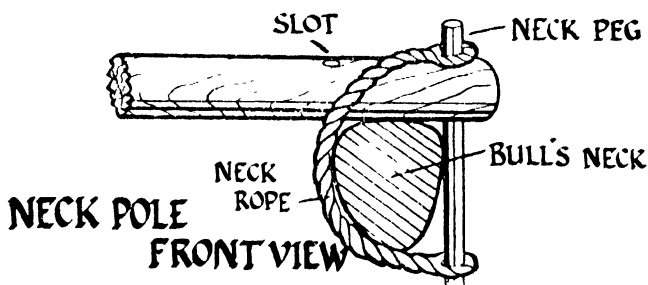
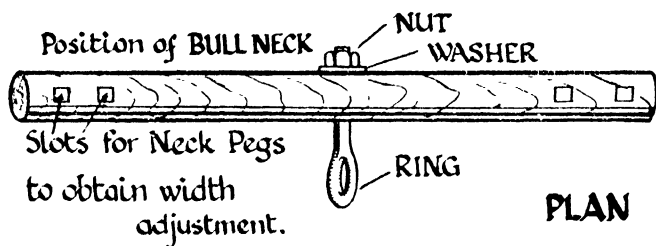
20 lb. fodder—millet stalks, chopped straw, hay, lubia leaves, earthnut leaves, and lucerne.

Both sesame and cotton cake are best crushed before feeding, and maize and millet to be properly digested should also be rough crushed. Beans and lubia seed require soaking before feeding, otherwise they may cause "hoven." Three-quarters of the fodder should be given dry and the other quarter green; this small amount of green food will act as a laxative and keep the animals in a good condition. For fattening thin animals lubia leaves are unequalled.

WORKING OF CATTLE.

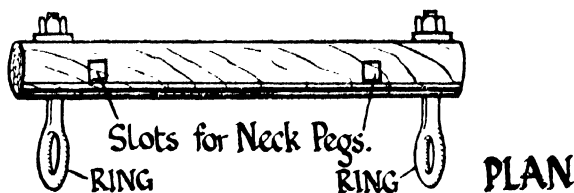
Means of Control.—The head rope should either be taken off or disconnected and a fine nose rope fitted. This nose rope replaces the cruel native practice of tying the ears to check the animals, and it is much more effective and humane (Fig. 3).

Yoking Cattle in Pairs.—A neck pole is necessary. It should be well rounded where it comes in contact with the animal's neck,



and if padded with soft leather or sacking it is less liable to chafe. In the centre of the neck pole should be fitted a bolt with a ring for coupling up the implements, etc. (see diagrams).

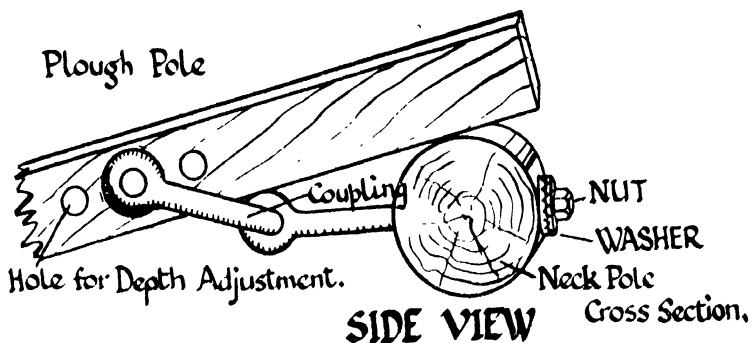
Yoking Single Cattle.—A short neck pole is required with a ring at each end (see diagram).



IMPLEMENTS RECOMMENDED.

- (i.) *Plough.*—Ransome's E.T. one-way (see Fig. 4).
- (ii.) *Ridger.*—Above with ridging attachment.
- (iii.) *Hoe.*—Above with hoeing attachment.

This plough can be attached to the neck pole in the following manner:



(iv.) *Clod Crusher.*—Crushing can be done by dragging an iron rail over the surface of the ground after weathering action has had time to take place.

(v.) *Soil Scoop.*—This is required for levelling irrigated areas (Fig. 5).

The above list of implements should be adequate for all normal cultural operations for rain and irrigated areas.

SOME TECHNICAL NOTES ON THE USE OF CATTLE AT DAUDAWA, NORTHERN NIGERIA

THE article entitled " Cotton in Northern Nigeria " by Mr. G. Browne, which appeared in Vol. XIII., No. 1, of the Review (January, 1936), has led to requests for further information, particularly as regards the method mentioned of yoking a single bullock in a cattle cart. The accompanying illustration of his method has accordingly been supplied by Mr. Browne, who would be interested to hear from readers whether similar methods are in use elsewhere. The raw-hide straps should be at least 2 inches and preferably 3 inches wide, and it is important that they should be slack enough for easy movement. Thus yoked an animal moves much more quickly than a pair yoked in the ordinary way, and the load almost equals that usually hauled by a pair of bullocks.

Further details have also been asked for regarding the cattle carts mentioned in the article, and Mr. Browne has therefore included in the illustration sketches of the ironwork which is turned out on the Station. The carts are built as nearly as possible on English lines, but with smaller bodies, which are 6 feet long by 3 feet 6 inches wide and 16 inches deep at the front, decreasing in depth to 14 inches at the back. The bodies are built on the Station of hard wood, the soles and cross members being in 3×4 inch timber, the latter carried well out so as to provide sufficient bracing room for the ironwork supports. The use of nails and screws is avoided so far as possible, bolts and nuts being used instead. Shaft breakages have been slight, although the timber used is light, about $3 \times 2\frac{1}{4}$ inches, but provision is made for easy replacement, as will be seen from the sketch. The tail-board is held in position by replacing the key shown in the drawing over the metal projection attached to the cart's side. On being released the heavy tapered end swings down and the keyway locks on the metal pin.

The bodies are mounted on steel wheels and axles, which have been manufactured for this purpose by Messrs. Ransomes, Sims and Jefferies, and cost £3 per set f.o.b. London. The wheels are 3 feet 6 inches in diameter and have 4-inch tyres. The hub caps can be

unscrewed for lubrication. The axle is square in section to simplify the attachment of the body. A sketch of the method of attachment is given in Fig. 10. The rivet holes are placed so as to give the wheels about $\frac{1}{8}$ inch clearance, and the axles are mounted about 3 inches forward of the centre of the cart body in order to counter-balance the shafts.

To fill in the transition period before a mixed farmer can afford a cart, Mr. Browne has devised a sledge as a result of a series of trials. At present two have been made: they are used by their owners every day, and Mr. Browne does not think that they will ever be without them, even when they can afford a cart. The "body" or floor of the sledge measures 4 feet $\times$ 3 feet and the sides are edged by four bevelled boards. These retain the load yet do not hinder its removal from any side of the sledge. The runners are made of 2-inch timber, 10 to 12 inches deep so that the sledge clears ridges in the fields, and to provide good clearance the cross pieces supporting the floor are mortised into the runners as high as possible. A strip of 1 $\times$ $\frac{1}{4}$ inch iron is run along the full length of the centre of the runner. The total cost, counting carpenter's time, is less than 10s.

Mr. Browne stated in the article in the January issue of the Review that a pair of bullocks can plough two to three acres a day. He wishes to point out that in Nigeria this is not ploughing in the proper sense of the word, and that ridging is always referred to locally as ploughing.

As regards training the animals for work, it has been found, so far as Daudawa is concerned, that the Nigerian cattle can be broken in most easily by drawing a log to commence with, then a cart which, having a "run," is not a dead weight, and finally a plough. This avoids waste of time during the training period, as wood is always wanted for some purpose or other about a farm, and the cattle in training can be employed in this work. The men in charge should keep the cattle moving smartly from the beginning of their training, and, unless absolutely necessary, the use of sticks or whips should not be allowed. Words of command should be used to indicate the driver's wishes, and he should take every opportunity of "handling" each animal, so that it gets not only used to being handled, but learns to like its owner to touch it. The cattle are trained to work from either side from the first time they are yoked.

DESCRIPTIONS OF DIAGRAMS.

I.—DESIGN FOR CART AND OX HARNESS, BY G. BROWNE.

(Details of Cart not to Scale.)

- FIG. 1.—Rawhide straps. These are attached to staples in the shaft. The draught strap should go from back staple to back staple, and the breech strap from front to front. All straps should be slack enough to allow of free and easy movement of animal.
- FIG. 2.—Indicates how shafts can easily be replaced if broken.
- FIG. 3.—Cross-piece connecting shaft ends, to strengthen.
- FIG. 4.—Draught strap.
- FIG. 5.—Breech strap.
- FIG. 6.—Girth.
- FIG. 7.—Iron support for cart sides, side elevation.
- FIG. 7a.—Iron support for cart sides, front elevation.
- FIG. 8.—Fix to bottom of tailboard: flap curved outwards.
- FIG. 9.—Fix to rear of cart body.
- FIG. 10.—Axle-end section. Angle irons riveted to sides of axle to provide mounting for cart sole pieces.
- FIG. 11.—Cartside.
- FIG. 11a.—Tailboard.
- FIG. 12.—Tailboard—key ready to fix.
- FIG. 13.—Tailboard—key fixed in position.

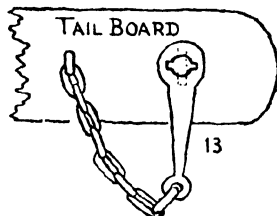
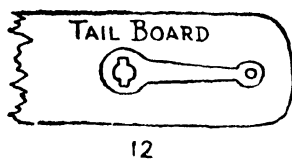
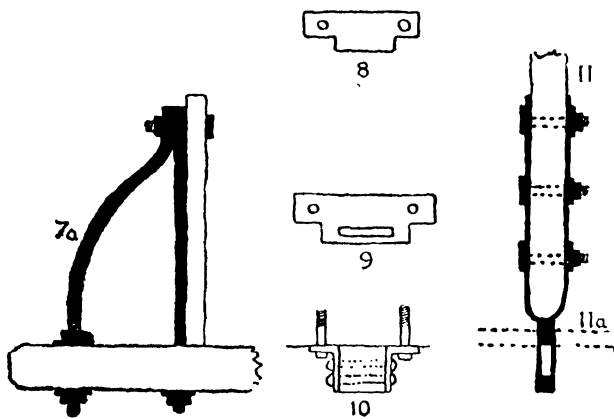
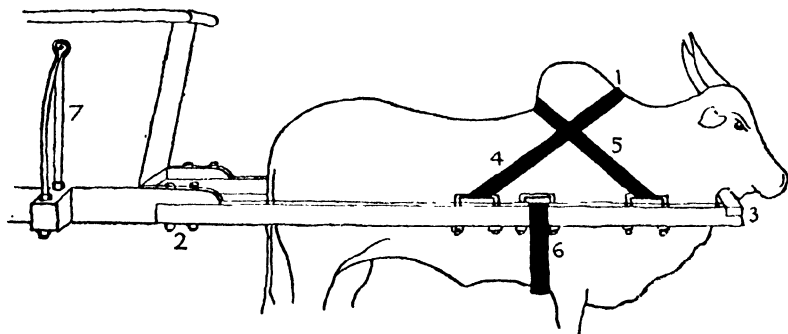
II.—DESIGN FOR SLEDGE, BY G. BROWNE.

(Not accurately to scale.)

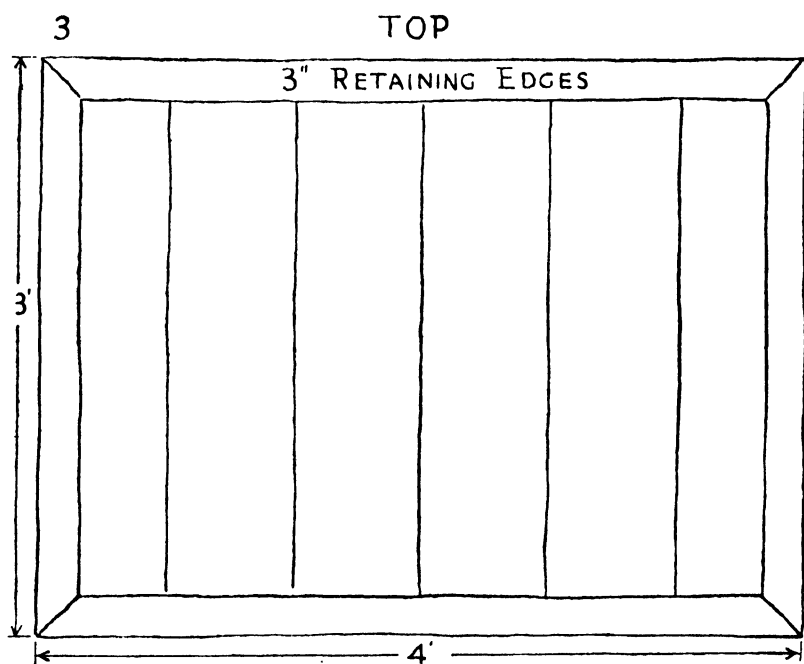
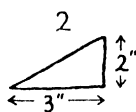
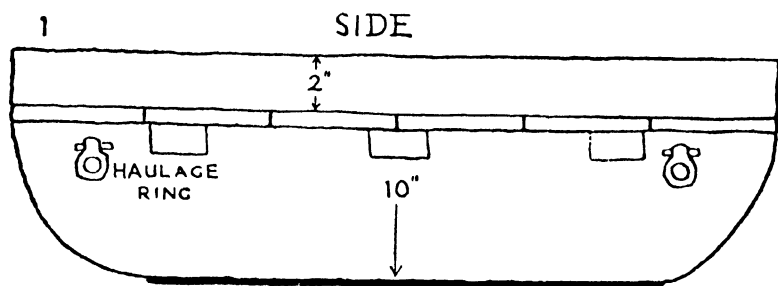
- FIG. 1.—Side view of sledge.
- FIG. 2.—Cross-section of retaining edge.
- FIG. 3.—Top view of sledge.

We are indebted to Professor R. C. Wood for the diagrams, which he has been kind enough to draw from Mr. Browne's sketches.

I



II



COTTON STATISTICS

BY

JOHN A. TODD, M.A., B.L.

American Crop.—In the July issue under the heading of Prices we pointed out that as the result of the Government's handling of the Pool cotton the price of American was being steadily edged upwards. The first move in the opening of the new season, namely the publication of the Government's first estimate of acreage on July 8, gave a very strong impetus to this movement when it was discovered that the acreage planted was estimated at only 30,621,000, or 9·8 per cent. above the final revised figures of last year. This apparently meant that the acreage restriction scheme under the Soil Conservation Act had proved to be much more successful than anyone had anticipated, though it was also pointed out that owing to severe drought in the eastern part of the Belt in the early months of the season a good deal of acreage had been abandoned after planting. This of course did not appear in the estimate, which is of acreage planted *and in cultivation* as at July 1.

Up till the end of June the weather had been on the whole distinctly unfavourable, with extremes of drought and excessive rainfall in rapid succession over different parts of the Belt, but during July the weather improved greatly, except in Oklahoma where the drought continued, and the result was shown in the fact that the first Bureau of the season on August 8 gave a crop of 12,481,000 bales, making the average yield 199·7 lbs. per acre, which is the highest figure ever shown by the August Bureau. As a matter of fact, however, the Department of Agriculture has lately been once more revising its acreage figures for recent years (in every case downwards), which has raised many of the average yield figures of recent years and makes exact comparison difficult.

The second Bureau on September 8, however, completely reversed the situation, showing a heavy reduction in the condition and probably the greatest reduction on record for this month in the yield per acre and the indicated crop, which was reduced to 11,121,000 bales. The abandonment was also above the average, making the acreage left for harvest only 29,720,000 acres.

Egyptian.—Our second table of the Egyptian crop, which gives the full details of the 1935-36 acreage and yield by varieties, contains only the acreage figures for the new crop. These show, as was expected, a much smaller acreage under Sakel and a substantial increase in Giza 7, but the nett increase is very small, especially in view of the fact that last year's acreage was thought to be under-estimated. That incidentally was believed to be partly the explanation of the very high average yields given for many of the varieties last season. It is to be noted that Pilion dropped out of the statistics in 1935 and Casouli and Nahda this year when Giza 12 made its first appearance.

Indian Crop.—Our next table of the Indian crop gives the final figures of the 1935-36 crop with the revised figures of 1934-35. Here again it is to be noted that the Government have revised the total crop figure of 1933-34 but have not revised the separate figures for long and short staple, so that these do not now tally with the total. It may be noticed that the allocation between long and short staple given here does not tally with the figures given in the July issue (page 211). This is due to the fact, referred to in that issue, that the Government at a later date publish more detailed figures of the allocation in which part of the Broach crop is transferred to short staple and part of the Central Provinces crop to long staple. The nett effect of these transfers is to make the percentage of short staple considerably larger.

The Commercial Crop figures for 1935-36 are of course not yet available, but it is worth noting that Ralli's estimate, which is usually more in line with the commercial crop figures, is still 7,097,000 bales, a new record.

World's Carryover of American Cotton.—To complete this table at the end of July we require the World's Mill Stocks other than in the U.S.A., for which we use the Federation figures. We hope that these will be available before this issue goes to press, but in case they should not be it may be mentioned that the New York and New Orleans Cotton Exchanges have already published their figures of the Carryover at the end of the season. Garside's preliminary figure is 7,100,000 bales against 9 041,000 last year, and the New Orleans figure 6,732,000 bales against 8,728,000 last year. Our own figure should work out pretty closely in line with Garside's.

World's Consumption.—These figures for the complete season 1935-36 will also not be available till the first week of September, and when the Federation figures for the second half of the season do appear there will be the same trouble as there was six months

ago in the absence of the German and Italian figures, and possibly also now the Spanish figures. We hope, however, to be able to make some kind of an estimate of these figures so as to include a total in this table, but in the meantime it may again be noted that Garside's preliminary estimate of the World's Consumption of American for the season was 12,475,000 bales against 11,206,000 last season, and of Outside Growths 14,739,000 against 14,222,000 last year. This makes his total World's Consumption of all kinds 27,214,000 bales against 25,428,000 last year. The New Orleans Cotton Exchange estimate of the world's consumption of American is 12,405,000 bales against 11,325,000 last year.

U.S. Consumption.—The main feature of this table is the very high figures throughout the second half of the season, which make the total of 6,348,423 bales of all kinds, the highest total since 1928-29 (7,091,065). Here again it is to be noted that this total does not tally with the U.S. Consumption figure in the World's Consumption table above, because the Federation figures are given throughout in running bales, whereas the U.S. Census Bureau's figures convert all foreign cottons into equivalent 500 lb. bales. The U.S. totals are therefore rather higher than the Federation totals.

Prices.—The table of Futures prices gives the monthly details throughout the season. The July figures, however, which are for October futures, do not fully represent the extent of the rise because as a matter of fact, owing to the virtual corner of the market through the Government's holdings, the July contract in New York actually went out at 13·43 cents. After that, however, prices fell back considerably, and the high figures of the August Bureau produced a further decline, which continued throughout the month in spite of adverse crop reports.

In the Egyptian market, however, there was a still greater rise, especially in Sakels, for towards the end of the season the Liverpool Sakel contract once more demonstrated the fictitious position of the contract by rising to the highest premiums against American that it has touched since October, 1931. This is of course the result of the peculiar position of the Liverpool Sakel contract, against which only Sakel (Egyptian or Sudan) is tenderable. Owing to the steady decline of the production of Egyptian Sakel, which is reaching its climax in the 1936 figures, there is now very little of this tenderable against the contract. In 1935 a large proportion of the Egyptian Sakel crop of 901,190 kantars proved to be untenderable against the Liverpool contract, and as the Sudan Sakel crop is now about as large as the Egyptian the effect is that the Liverpool

Sakel contract is very much at the mercy of the holders of Sudan Sakel.*

Our last table of the Spot prices of other varieties expressed as a percentage of American shows the effect on relative prices of the appreciation of American, which as usual was reflected in relatively lower prices for Outside Growths. Indian, however, exceptionally showed a much higher percentage in July. The abnormal position of the Egyptian futures market in Liverpool is reflected in the very high premiums of the spot prices, especially of Sakel.

P.S. 10.9.36.—The Federation statistics have just been issued and as expected contain no figures at all for Germany and Italy, for which, therefore, we have no alternative but to repeat last year's figures, and only estimates for Russia and Spain. On this basis their totals are 12,764,000 bales of American (285,000 bales more than Garside) and 14,775,000 bales of Outside Growths (against 14,739,000). The total World Consumption of All Kinds is therefore 27,539,000 bales against the Federation's previous record of 26,139,000 bales in 1926-27.

The Federation Mill Stocks of American outside of the U.S.A., which are subject to the same difficulties of estimation, are included in the table of the World's Carryover of American, and make the total 6,991,000 bales against 9,003,000 last year.

It may be noted here that the World's Carryover of Egyptian Cotton at 31st July was 3,365,000 kantars against 3,569,000 a year ago. Details will be given in our next issue.

* It is understood, however, that a new contract has been under consideration for some time, and that it is hoped it will be adopted shortly.—Ed.

AMERICAN CROP (EXCLUDING LINTERS).

	1930-31.	1931-32.	1932-33.	1933-34.	1934-35.	1935-36.
Acreage planted (000's)	43,329	39,110	36,494	40,248	27,860	27,888
Acreage harvested ...	42,444	38,704	35,891	29,383*	26,866	27,335
Crop (running bales)...	13,756	16,629	12,710	12,664	9,472	10,420
Yield per acre (lbs.)...	157.1	211.5	173.5	212.7	171.6	186.3
Season's average spot price (Liverpool—pence per lb.) ...	5.71	4.82	5.62	6.02	6.93	—

PROGRESS OF THE SEASON 1936-37.

	August.	Sept.	Oct.	Nov.	Dec.	March.
Acreage planted ...	30,621	30,621				
Acreage harvested ...	29,924	29,720				
Crop (500 lb. bales) ...	12,481	11,121				
Yield per acre (lbs.)...	199.7	179.2				

* Less 10,396,000 acres special abandonment.

EGYPTIAN AREA AND CROP BY VARIETIES.

(THE CROP ESTIMATES EXCLUDE SCARTO.) 000's OMITTED.

	1934.			1935.			1936.
	Area : Feddans	Crop : Kantars	Average Yield	Area : Feddans	Crop : Kantars	Average Yield	Area : Feddans
<i>Long Staple :</i>							
Sakel	420	1,003	2.39	297	901	3.03	163
Maarad	54	207	3.80	82	362	4.43	72
Giza 7	287	958	3.34	270	1,267	4.70	407
Sakha 4	10	38	3.84	28	118	4.28	42
Casouli	3	12	3.60	3	7	2.97	—
Group Total	774	2,218	2.87	679	2,656	3.91	683
Per Cent. of Total ...	44.7	30.0	—	40.7	31.8	—	39.8
<i>Medium :</i>							
Nahda	10	35	3.42	5	27	5.16	—
Fouadi	39	117	2.96	32	138	4.38	19
Pilion	8	23	2.97	—	—	Giza 12	6
Giza 3	10	37	3.84	10	30	2.93	9
Others*	—	—	—	5	13	2.80	1
Group Total	67	212	3.17	52	208	4.03	35
Per Cent. of Total ...	3.9	2.9	—	3.1	2.5	—	2.0
<i>Short :</i>							
Ashmouni and Zagora ...	886	4,945	5.58	938	5,478	5.84	998
Others*	6	17	2.93	—	—	—	—
Group Total	891	4,962	5.57	938	5,478	5.84	998
Per Cent. of Total ...	51.4	67.1	—	56.2	65.7	—	58.2
Grand Total	1,732	7,391	4.27	1,669	8,343	5.00	1,716
Per Cent. Change in Acreage	-4.0	—	—	3.6	—	—	+2.8
Lower Egypt	1,175	—	—	1,113	—	—	1,127
Upper Egypt	557	—	—	556	—	—	589
Per Cent. of Total ...	32.2	—	—	33.3	—	—	34.3

* Others transferred from Short to Medium in 1935.

INDIAN CROP.

(000's Omitted.)

	1930-31.	1931-32.	1932-33.	1933-34.	1934-35	1935-36.
Area (acres)	23,812	23,722	22,483	24,137	24,023	25,138
Crop (Government estimate)						
400-lb. bales	5,226	4,007	4,656	5,108	4,858	5,728
Average yield per acre (lbs.)	88	68	83	84	81	91
Staple $\frac{3}{4}$ and above (bales)	1,225	1,306	1,347	1,394	1,239	1,813
Per Cent. of Total	23.4	32.6	28.9	27.5	25.5	31.7
Staple below $\frac{3}{4}$ (bales) ...	4,001	2,701	3,309	3,674	3,619	3,915
Per Cent. of Total	76.6	67.4	71.1	72.5	74.5	68.3
Commercial Crop :						
Net exports (bales)	3,729	1,582	2,868	3,406	3,115	—
Mill consumption	2,271	2,346	2,361	2,336	2,612	—
Domestic consumption	750	750	750	750	750	—
Total	6,750	4,678	5,979	6,492	6,477	—
Per cent. on Government estimate	+ 29.2	+ 16.7	+ 28.4	+ 27.1	+ 33.3	—
Season's average spot price (Liverpool—pence per lb.)	4.02	4.32	4.84	4.52	5.24	—
Per cent. on American	70.4	89.6	86.1	75.1	75.6	—

WORLD'S CARRYOVER OF AMERICAN COTTON.
(RUNNING BALES 000's, EXCLUDING LINTERS IN U.S.A.)

End of	Stock and Afloat.			U.S.A.			Federation. Other Mill Stocks.	Half- Yearly Totals.	Else- where in U.S.A.*
	U.K.	Conti- nent.	Orient.	Mill Stocks.	Public Ware- houses.	Monthly Totals.			
1929, July	442	563	—	932	923	2,860	1,197	4,332	275
1930, January	618	1,198	448	1,730	5,343	9,337	1,007	10,344	—
July	304	544	143	1,048	2,803	4,842	937	6,249	470
1931, January	644	1,198	343	1,523	7,895	11,603	907	12,510	—
July	436	766	401	922	4,491	7,016	950	8,816	850
1932, January	506	938	805	1,583	10,019	13,851	1,193	15,044	—
July	415	729	695	1,163	6,657	9,659	1,379	12,798	1,760
1933, January	620	1,189	852	1,455	9,982	14,098	1,248	15,346	—
July	536	1,058	616	1,298	5,703	9,211	1,259	11,550	1,080
1934, January	617	1,367	752	1,557	9,469	13,762	1,320	15,082	—
July	405	734	590	1,172	5,526	8,427	1,132	10,509	950
1935, January	397	640	768	1,148	8,912	11,865	1,060	12,925	—
February	363	619	739	1,117	8,338	11,176	—	—	—
March	341	567	647	1,074	7,751	10,380	—	—	—
April	323	548	595	1,020	7,168	9,654	—	—	—
May	276	510	510	938	6,526	8,760	—	—	—
June	267	493	445	843	6,045	8,093	—	—	—
July	201	395	315	749	5,708	7,368	955	9,003	680
August	180	342	238	606	5,865	7,231	—	—	—
September	172	373	232	682	7,126	8,785	—	—	—
October	324	450	307	1,041	8,463	10,585	—	—	—
November	418	658	412	1,314	8,613	11,415	—	—	—
December	501	797	499	1,397	8,367	11,561	—	—	—
1936, January	493	614	565	1,404	7,822	10,898	858	11,756	—
February	463	637	457	1,372	7,223	10,152	—	—	—
March	420	665	405	1,302	6,543	9,335	—	—	—
April	385	593	371	1,155	5,992	8,496	—	—	—
May	362	523	323	1,053	5,205	7,468	—	—	—
June	356	471	251	944	4,498	6,520	—	—	—
July	321	359	195	856	3,893	5,624	792	6,991	575
August	248	291	172	—	—	—	—	—	—

Included in total,

WORLD'S CONSUMPTION OF COTTON.
(FROM THE STATISTICS OF THE INTERNATIONAL FEDERATION.)
(Running Bales, 000's—Excluding Linters.)

Variety.	Season.	U.K.	Continent.	U.S.A.	Asia.	Others.	Totals.
<i>American.</i>	1930-31	901	3,242	5,084	1,345	239	10,901
	1931-32	1,342	3,343	4,744	2,636	251	12,316
	1932-33	1,400	3,836	6,004	2,655	276	14,171
	1933-34	1,461	3,976	5,553	2,238	306	13,534
	1934-35	1,049	2,782	5,241	1,997	285	11,354
	1935-36	1,378	3,063	6,219	1,793	311	12,764
<i>Indian.</i>	1930-31	252	1,215	43	4,318	35	5,863
	1931-32	183	727	21	3,834	23	4,788
	1932-33	126	600	16	3,455	23	4,220
	1933-34	234	844	14	3,638	42	4,772
	1934-35	342	880	22	4,501	18	5,772
	1935-36	386	932	55	4,352	26	5,751
<i>Egyptian.</i>	1930-31	242	420	70	96	25	853
	1931-32	301	480	53	120	26	980
	1932-33	301	442	58	104	29	934
	1933-34	366	515	69	119	39	1,108
	1934-35	362	552	55	185	41	1,195
	1935-36	356	577	45	164	43	1,185
<i>Sundries.</i>	1930-31	479	1,984	42	1,648	711	4,864
	1931-32	560	1,730	26	1,133	786	4,235
	1932-33	421	1,797	32	1,922	856	5,028
	1933-34	409	2,137	33	2,154	964	5,697
	1934-35	754	3,099	19	2,456	1,152	7,480
	1935-36	613	3,225	19	2,694	1,288	7,839
<i>All kinds.</i>	1930-31	1,964	6,861	5,239	7,407	1,010	22,481
	1931-32	2,386	6,280	4,844	7,723	1,086	22,319
	1932-33	2,248	6,675	6,110	8,136	1,184	24,353
	1933-34	2,470	7,472	5,669	8,149	1,351	25,111
	1934-35	2,507	7,322	5,337	9,139	1,496	25,801
	1935-36	2,733	7,797	6,338	9,003	1,668	27,539

U.S. CONSUMPTION OF COTTON BY VARIETIES.
(RUNNING BALES 000's: "FOREIGN" IN EQUIVALENT 500-LB. BALES.)

1934-35.	Total.	Daily Rate.	Upland.	American Egyptian.	Egyptian.	Other Foreign.	Linters not Included.
November ...	477.1	22.2	465.1	0.8	8.5	2.7	51.4
December ...	413.5	21.8	403.5	0.8	6.8	2.5	52.1
January ...	546.8	24.0	534.3	0.9	8.7	2.9	61.8
February ...	478.3	24.2	467.1	0.7	7.3	3.1	62.8
March ...	481.1	22.9	469.6	0.8	6.9	3.8	66.8
April ...	462.8	21.3	450.8	1.1	6.8	4.1	70.3
May ...	469.2	20.6	458.8	1.4	5.7	3.4	65.5
June ...	385.9	19.3	376.8	1.3	4.6	3.2	61.9
July ...	391.8	17.8	382.0	1.3	4.7	3.8	62.1
1935-36.							
August ...	408.4	18.6	397.9	2.0	4.7	3.9	57.9
September ...	449.1	21.4	437.6	1.8	5.5	4.2	61.1
October ...	552.2	24.0	538.5	2.0	6.4	5.3	67.1
November ...	507.8	24.8	496.1	1.8	5.2	4.8	59.5
December ...	498.3	26.2	487.3	1.8	5.5	3.7	55.2
January ...	591.3	26.0	578.1	2.2	6.6	4.4	56.0
February ...	516.6	25.8	504.2	1.9	5.6	5.0	53.6
March ...	548.9	25.0	536.9	1.8	5.0	5.3	60.8
April ...	576.8	26.5	562.7	1.7	5.8	6.6	61.4
May ...	530.8	25.3	518.3	1.4	5.2	5.9	64.7
June ...	556.3	25.3	542.8	1.4	5.3	6.9	64.0
July ...	603.2	26.2	588.3	1.8	6.1	7.0	70.2

HIGHEST AND LOWEST FUTURES PRICES.

1934-35.	<i>American.</i>				<i>Egyptian (Liverpool).</i>			
	<i>New York.</i>		<i>Liverpool.</i>		<i>Sakel.</i>		<i>Uppers.</i>	
	<i>High.</i>	<i>Low.</i>	<i>High.</i>	<i>Low.</i>	<i>High.</i>	<i>Low.</i>	<i>High.</i>	<i>Low.</i>
February	12.73	12.26	6.88	6.68	8.58	8.36	7.58	7.38
March ...	12.49	<i>10.25</i>	6.97	5.95	8.61	7.69	7.65	6.70
April ...	11.90	10.83	6.54	5.97	8.16	7.86	7.34	6.87
May ...	12.19	10.95	6.56	6.29	8.16	7.86	7.47	7.16
June ...	11.58	10.56	6.17	<i>5.74</i>	7.91	<i>7.62</i>	7.03	<i>6.66</i>
July ...	11.80	11.30	6.28	6.12	7.89	7.67	7.10	6.97
1935-36.								
August ...	11.60	<i>10.31</i>	6.22	<i>5.63</i>	7.86	7.58	7.04	6.42
September	10.81	10.31	5.97	<i>5.52</i>	8.01	<i>7.48</i>	6.82	<i>6.38</i>
October ...	11.27	10.54	6.21	<i>5.77</i>	8.42	7.78	6.87	6.51
November	11.97	10.86	6.54	6.07	9.51	8.44	7.77	6.82
December	11.77	11.01	6.49	6.14	9.20	8.57	7.71	7.28
January ...	11.58	10.90	6.24	5.77	9.22	8.54	7.53	7.03
February	10.99	10.63	5.87	5.62	8.81	8.29	7.14	6.84
March ...	11.34	10.59	6.08	5.66	8.76	8.34	7.20	6.90
April ...	11.31	10.80	6.11	5.83	8.72	8.45	7.18	6.94
May ...	11.58	11.02	6.13	5.93	8.68	8.48	7.30	6.95
June ...	11.79	10.60	6.34	<i>5.79</i>	9.20	8.44	7.45	6.84
July ...	<i>12.78</i>	11.51	<i>6.84</i>	6.23	<i>11.04</i>	9.14	7.92	7.35
1936-37.								
August ...	12.16	11.30	6.53	6.10	10.79	9.96	7.49	6.99

Maximum and minimum each season in italics.

LIVERPOOL SPOT PRICES OF AMERICAN WITH OTHER VARIETIES
AS PERCENTAGES (LAST FRIDAY OF EACH MONTH).

1934-35.	American (Middling). Pence per Lb.	Indian No. 1 Fine Omra.	West African (Middling).	Brazil.		East African (Good Fair).	Tangais (Good).	Uppers (F.G.F.).	Sakel (F.G.F.).
				Pernam (Fair).	San Paulo (Fair).				
February	7.10	77.5	99.3	96.5	98.6	110.6	113.4	107.3	124.8
March ...	6.36	80.3	99.5	96.4	98.7	112.1	114.5	116.8	130.3
April ...	6.78	82.2	99.3	96.3	98.5	111.1	113.3	117.1	124.6
May ...	6.92	77.7	97.1	94.9	97.1	107.2	109.4	109.8	117.9
June ...	6.85	80.0	98.5	96.4	98.5	108.8	109.5	108.2*	117.2
July ...	6.80	81.8	100.0	96.3	98.5	106.6	108.8	108.5	118.7
Season's average	6.93	75.6	98.7	95.5	97.4	108.4	113.6	109.2	122.9
1935-36.									
August ...	6.21	76.0	100.0	95.2	97.6	106.4	108.9	114.2	128.0
September	6.40	78.6	100.0	96.1	98.4	105.5	109.4	112.3	133.1
October ...	6.47	84.7	100.8	98.5	100.8	109.3	117.0	107.3	140.8
November	6.59	87.3	101.8	99.5	101.8	111.7	119.3	120.2	153.9
December	6.41	87.8	101.6	100.0	102.3	111.3	119.5	120.1	148.8
January ...	6.14	82.9	101.6	100.0	102.4	113.8	121.2	119.1	157.8
February	6.04	82.3	100.8	99.2	101.7	111.6	121.5	116.9	149.5
March ...	6.44	78.6	100.0	96.9	100.8	110.1	119.4	114.4	142.9
April ...	6.62	76.6	100.0	97.0	100.8	109.8	118.9	112.5	138.2
May ...	6.64	72.6	99.2	94.7	99.2	106.0	118.1	113.6	130.6
June ...	7.18	73.8	98.6	93.0	95.8	104.2	115.3	112.3	128.8
July ...	7.10	79.6	97.9	92.3	94.4	103.5	115.5	126.1	158.2
Season's average	6.52	79.9	100.2	96.8	99.7	108.9	116.6	114.7	141.4
1936-37.									
August ...	6.70	74.0	97.0	91.8	94.0	104.5	117.9	117.3	153.4

* New Contract.

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

530. The following reports have recently been received:

IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH: Ann. Rpt. for 1934-35.

PUSA: Sci. Rpts. of Imp. Inst. of Agr. Res., 1933-34.

531. REPORT OF THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, 1934-35. (Pubd. by Manager of Pubns., Delhi. 1936. Price: Re. 1, or 1s. 9d.). An account of the work of the year in connection with animal husbandry, agricultural research, the sugar industry, soil investigations, and locust control. The enquiry into the costs of production of crops in the principal sugarcane and cotton-growing areas was continued.

532. REPORT ON THE STAPLE LENGTH OF THE INDIAN COTTON CROP OF THE 1935-36 SEASON. (*Stat. Leaflet No. 1*, 3rd issue, 1935-36. Ind. Cent. Cott. Comm.) The crop of 1935-36 is estimated to produce in bales of 400 lb.:

					Bales.
Long staple, over 1 inch	...	...	...	...	85,000
Medium staple, $\frac{7}{8}$ to 1 inch	...	...	...	...	1,728,000
Short staple, below $\frac{7}{8}$ inch	...	...	...	...	3,915,000
Grand total =					5,728,000

533. INDIAN COTTON CHART, 1935-36. We have received from Messrs. Chunilal, Mehta and Co., Bombay, a copy of their annual cotton chart, which is published for the twelfth year in succession. The chart is issued at the termination of the Broach contract for April-May delivery. The usual April-May Broach quotations in Bombay and corresponding contract quotations for American cotton in Liverpool and New York are given, and in view of the exceptional circumstances governing the silver market during the year, the spot quotations for silver in London are included. The London-New York cross rate, which was a feature in the last cotton chart, is omitted, since very stable conditions prevailed in the relationship between sterling and the U.S. dollar. Figures are included for acreage, crop, and yield per acre for Indian and American cotton for the 1935-36 season, and also acreage, crop, and yield per acre figures for the Indian crop for the past ten years.

534. A NEW DESI COTTON, MOLLISONI 39. By M. Afzal. (*Seasonal Notes*, xiv., 1, Punjab Agr. Dpt., 1936, p. 6.) A cotton yielding 15·8 maunds to the acre, evolved as a result of research work carried out under the Punjab Botanical Research Scheme, Lyallpur, financed jointly by the Indian Central Cotton Committee and the Punjab Government. The cotton has been approved by the Punjab Dept. of Agriculture for general distribution.

535. UNITED PROVINCES. *Cotton Varietal Trials*, 1933-34. (*Triennial Rpt. Dpt. of Agr., U.P.*, 1932-33 to 1934-35.) The varieties under trial were A. 19, C. 520, C. 402, Raya-American, Punjab-American, and Saugarjari. A. 19 and C. 520 were the heaviest yielders, but the quality of C. 402 was definitely superior. This under good selling conditions may bring the grower about Re. 1 per maund over C. 520, but as the yield is usually from 25-40 per cent. less the price difference

can hardly be said to make it a better proposition for the grower, particularly as it requires better cultivation. The yields of Raya, Punjab-American and Saugarjari cottons were poor, and these strains are not worth continuing.

536. THE INDIAN COTTONS. By D. F. Kapadia. (*Text. Wkly.*, xviii., **436**, 1936, p. 37.) A discussion of prices in relation to quality, staple, and yield.

537. INDIAN COTTON TRADE: COMPETITION. By S. Sen. (*Wirtschaftsdienst*, **21**, 1936, p. 437. From *Summ. of Curr. Lit.*, xvi., **9**, 1936, p. 258.) The author discusses the competition between Indian mills, England and Japan, for the yarn and piece-goods trade of India. Statistics are given.

538. THE EFFECTS OF STORING COTTON BALES IN THE OPEN AND INSIDE A SHED AT KARACHI. By N. Ahmad. (*Tech. Bull.*, Ser. A. No. 30. Ind. Cent. Cott. Comm., 1936.) The conclusion was reached that cotton stored under dry conditions was much more resistant to the disruptive action of micro-organisms than that stored under damp conditions.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

539. The following reports have recently been received:

THE JOURNAL: South-Eastern Agr. Coll. Wye. July, 1936.

KENYA COLONY: Ann. Rpt. of Dpt. of Agr., 1934. Vols. i. and ii.

NIGERIA: Eleventh Ann. Bull., 1932.

„ Northern Provinces, Ann. Rpt. for 1935.

NORTHERN RHODESIA: Ann. Rpt. of Dpt. of Agr., 1935.

SOUTHERN RHODESIA: Rpt. of Chief Native Commissioner, 1935.

SUDAN: Rpt. of Govt. Chemist for 1935.

WEST INDIES: *Barbados*: Agr. Jour., vol. iv., **4**, 1935.

„ *Dominica*: Rpt. of Agr. Dpt., 1935.

540. ASIA. CYPRUS: Cotton Industry, 1934-35. (*Ann. Rpt. of Emp. Cott. Growg. Corpn.*, 1934-35, issued 1936.) Favourable weather conditions which prevailed throughout 1935, combined with more satisfactory prices, were responsible for an increase in the area under cotton, 14,319 acres being planted as compared with 9,028 acres in 1934. The yield per acre was higher than in any season during the previous four years, and the resulting crop amounted to 5,214 bales.

The Department of Agriculture has produced a promising selection from a Cyprus variety of cotton, and its production is being gradually extended. It would seem desirable that steps should be taken to secure multiplication of this strain in a pure state, so that it may replace the present mixed types that are grown; such action will be necessary if the growers are to obtain the best value from their crop.

541. AFRICA. KENYA: Cotton Cultivation, 1934-35. (*Ann. Rpt. Dpt. of Agr.*, 1934, recently received.) The total quantity of lint ginned was 3,500,000 lb. compared with 2,700,000 in the previous season; this constituted a record for the Colony. In the 1935-36 season it is confidently expected that well over 4,000,000 lb. lint will be produced.

Nyanza Province.—In the Uganda border region the area planted showed an increase of 25 per cent. over that of the previous year. Good cultural methods were employed, and natives displayed more keenness for the crop than had been known before. In Kavirondo, Gulf and Lake Shore areas cotton has been grown spasmodically during the past few years, but with the erection of a new ginnery at Kendu and encouragement from the Agricultural and Administrative Officers much more interest was shown by the growers, and a yield of over 900,000 lb. lint was obtained, compared with 70,000 in the previous season.

Coast Province.—The season was not as successful as had been hoped. Excessive rain ruined many of the earlier plantings and greatly reduced the quality of the crop. In the Nyika Reserve famine was a severe obstacle, and many of the natives went to the Coast belt, where increased cotton acreage was planted. It is expected that the yield will be greater than the previous year, though by no means what might have been expected under more favourable conditions. A redeeming feature was the higher price, which was 12 cents for first grade and 7 cents for second grade at the ginneries, the best price obtained since the depression.

542. Cotton Experiments, 1934. (*Ann. Rpt. Dpt. of Agr.*, 1934, vol. ii., recently received.) In experiments carried out at Kibu, lower Machakos, Fort Hall, Embu and Meru Districts the greatest success was obtained with U/4/4/2 cotton. Insect pests, especially stainers, were prevalent in August and September. Further tests were contemplated in 1935 to discover the best planting dates and the best times for ratooning.

543. Cotton Production, 1935-36. A note recently received from the Director of Agriculture is to the effect that the production of cotton has increased from 783 bales in 1930-31 to 15,588 bales in 1935-36. In Nyanza Province the whole of the crop is produced by natives; on the Coast, one European and a few Arabs have grown cotton this season, but all other producers are natives. The number of ginneries in the Colony is as follows: 5 in Nyanza Province, 2 in the Central and 2 in the Coast Provinces. In addition to ginning the crop, the ginners provide seed, with transport, for the following season's crop. The revenue from the 1935-36 crop amounted to £163,700.

544. INSPECTION NOTE ON THE KENYA COTTON CROP IN NOVEMBER AND DECEMBER, 1935. By S. Milligan. A note on a visit paid to Kenya at the request of the Government of Kenya and the Corporation to advise on the best means of expanding cotton cultivation in the Colony. As a result of his tour Mr. Milligan found that the most urgent consideration at the moment was the collection of information regarding the behaviour of cotton in the different areas, and the insect pests to be combated, rather than the expansion of the crop. He therefore suggested methods by which the work could be carried out by the Department of Agriculture; these included the appointment of three temporary Agricultural Officers to enable the technically trained Agricultural Officers to undertake the necessary additional investigational work. Mr. Milligan considered that if simple records were kept during the next three seasons the position could be clarified, and if further research work were then needed, he felt sure that an appeal to the Corporation would receive sympathetic consideration.

545. NIGERIA: Cotton Cultivation, 1935-36. (*Half-yearly Rpt. of Dpt. of Agr. to March 31, 1936.*) *Northern Provinces.*—The purchases of American cotton for export were slightly in excess of last year, and constituted a record for Northern Nigeria. The new regulations to control the marketing of cotton were in force during the season. The result of the application of these regulations is shown in the high percentage of Grade 1 cotton delivered at the markets. In Zaria Province 97 per cent. of the crop, in Northern Katsina 86 per cent., and in Sokoto Province 85.5 per cent. of the crop was classified as Grade 1. The demand for seed for planting in 1936 is in excess of that of the previous year, and again constitutes a record.

Southern Provinces.—The production of Improved Ishan cotton is estimated at 9,000 bales, compared with 5,208 bales in 1934-35. An increased demand for seed for planting in 1936 is expected.

546. NORTHERN PROVINCES: *Cotton Cultivation, 1934-35.* (*Ann. Rpt. on N. Provs., 1935.*) The posting of an Agricultural Officer to Bauchi Province was welcomed, since this province is considered very suited to cotton cultivation. The growing of American cotton is being encouraged in the north-west districts of the Bornu Province, and there are indications that the industry could be made profitable. Bornu Emirate, with its fertile soil and large numbers of village cattle, offers a promising field for the development of mixed farming. In the Kabba Province there has been increased production of cotton and purchases have reached a record. Most of the cotton produced in Kano Province is absorbed by the native spinning industry, the local prices are higher than the export prices, and the country cloth is in great demand. The use of cattle in cultivation is extending in Katsina, and the number of farmers employing this method is now 181, as compared with 87 last year. The efforts of the Agricultural Department and of the Native Administrations in the distribution of seed and the marketing of the cotton resulted in a record output for the season. In the Niger Province grading of the cotton has been undertaken, and approved markets will, in future, be gazetted. Arrangements have been made with the British Cotton Growing Association to post buyers with hand gins at Kontagora and Rijau, and this should prove a great convenience to the local producer.

547. NYASALAND: *Cotton Industry, 1934-35.* (*Econ. Condns. in S. Rhod., N. Rhod., and Nyasaland, 1935.* By J. W. Bridgen. Received from Dpt. of Overseas Trade, 1936.) The improved prices received by growers in 1934 led to a further extension of cultivation in 1935, and a record crop is expected. The British Cotton Growing Association and the Empire Cotton Growing Corporation have been of material assistance to the Protectorate in the production of cotton. The former has been for a number of years the only large purchaser of cotton, whilst the latter has, by its researches, provided a strain which has given to the grower the necessary encouragement which has resulted in greatly increased yields.

The period under review was marked by considerable improvement in communications. The Zambezi Bridge was completed and opened to traffic; the northern extension of the railway from Blantyre to Salima was completed; the Government made considerable progress with their programme of main and feeder roads to the railway, and last, but not least, an air service was inaugurated.

548. *Water Supply Investigation, 1935.* (*Geol. Survey Dept. Progress Rpt. No. 5, 1935.*) In the Salima area, Dowa District, six bore-holes and three dug wells were completed during the year. The Cotton Specialist reported in November, 1935, that a considerable amount of new clearing and settlement was taking place, and there was every indication that the bore-holes and wells would fulfil anticipations and encourage settlement of areas previously unoccupied owing to lack of surface water. The effect on the production of cotton was already appreciable, and further considerable increases were expected year by year.

549. *Cotton Prospects, 1936-37.* (*Crown Colonist, July, 1936, p. 328.*) Prospects are good generally, and excellent in the Central Shire and Chikwawa districts, and along the northern extension of the railway.

550. NORTHERN RHODESIA: *Cotton Industry, 1934-35.* (*Ann. Rpt. of Emp. Cott. Growg. Corp., 1934-35, issued 1936.*) The principal work during the season was the continuance of the investigations into the incidence of stainers. Efforts to establish cotton as a crop on European-owned farms have so far proved a failure, since these farms are for the most part situated in belts where stainer host plants are prevalent. The results obtained, however, from trial plots in native areas in which host plants are rare or absent, are encouraging. One interesting conclusion from the work which is being carried out by the Corporation's officer

in close collaboration with the Government Entomologist is that the stainer actually prefers the alternative wild food plants to cotton, and it is only when there is a shortage of such food that the cotton is attacked.

551. Cotton Investigations, 1935. (*Ann. Rpt. of Dpt. of Agr., 1935.*) The cotton trials commenced last year on plots in Namwala district, where *Thespesia rogersii*, a perennial host of stainers, was rare or absent, were continued this year. The plots were sited on native farms near Pemba, Namwala, Mumbwa, and Kalomo. Unfortunately very severe damage was caused by locusts, and the number of plots was considerably reduced, those at Kalomo being completely ruined. In addition the initial stands were generally poor as a result of unfavourable planting conditions, and the abnormally early onset of the dry season taxed the locust-damaged plants severely. In spite of these disastrous conditions fairly satisfactory yields were obtained where little stainer damage had been expected, and the records of stainer incidence not only threw fresh light on the problem, but substantiated the theory which had already been developed. The results are sufficiently encouraging to justify repetition and expansion of the experiment. A further pleasing feature is the change in the attitude of the natives within the trial areas from opposition and suspicion to interest and willingness to co-operate. This is particularly noticeable in Pemba, where many farmers applied for seed in the present season. Thirty growers have been chosen from among the applicants. [*Cf. Abstr. 20, Vol. XIII. of this Review.*]

552. SOUTHERN RHODESIA: Cotton Cultivation, 1934-35. (*Econ. Condns. in S. Rhod., N. Rhod., and Nyasaland, 1935.* By J. W. Brigden. Received from Dpt. of Overseas Trade, 1936.) The production of cotton was increased during the year, due to the prospect of slightly better prices, coupled with a reduction in ginning charges.

As a rotation crop cotton has few equals, and it is hoped that as a result of the valuable work of the Empire Cotton Growing Corporation production may be further increased. Steps are being taken to encourage production by natives, but at present a difficulty in the way is the lack of adequate marketing facilities.

553. Cotton Cultivation, 1934-35. (*Rpt. of Chief Native Comr., 1935.*) From this report we quote the following: "There is a steady forward movement in the cultivation of cotton, for which thanks are due to the Empire Cotton Growing Corporation. So as to popularise this economic crop (which has also values for rotation) in districts favourable to its growth, it will be planted in kraal school tuitional plots, as well as in those of the native agricultural demonstrators."

Cotton growing experiments were continued during the year. From eleven demonstration plots on an area of $7\frac{1}{2}$ acres a total yield of 2,705 lb. seed cotton was obtained, giving an average yield of 349 lb. an acre. The average yield was low owing to indifferent cultivation, but where proper attention was given excellent results were obtained. "Cotton is a crop well worth the attention of native farmers as it brings them a cash income, fits in well with crop rotations, and is beneficial to the soil."

554. SWAZILAND: Cotton Cultivation, 1934-35. (*Ann. Rpt. of Emp. Cott. Growg. Corp., 1934-35, issued 1936.*) The Government continue to interest themselves in the possibility of establishing cotton as a native-grown crop on account of the improvement which its cultivation will demand in native agricultural practice, including the introduction of rotation schemes in place of continual cereal cropping. A number of native demonstrators have been appointed, who have first of all received instruction in agriculture at school, and have then spent a year at the Corporation's Experiment Station. Owing to the broken nature of the country, supervision of these demonstrators is a difficult matter, and the Government

propose to appoint a junior Agricultural Officer for this work. The long period of drought experienced in 1934-35 resulted in only poor yields of cotton being obtained at the Experiment Station. Due to this cause also very little cotton was planted in Swaziland in the 1935-36 season. With reasonable planting conditions a considerably increased acreage would have been grown, as during the winter enquiries for seed were received from a large number of farmers, many of whom had not previously grown cotton or had given up production some years ago. Sufficient acreage has, however, been established to ensure the seed supply for next season.

555. TANGANYIKA TERRITORY: *Cotton Cultivation, 1934-35.* (*Ann. Rpt. Emp. Cott. Growg. Corpn.*, 1934-35.) The Department of Agriculture's propaganda for increased crop production continues to meet with great success, and is gradually raising the standard of living of the natives in many areas. The increase in the cotton crop has been most marked, the production for the season amounting to 57,750 bales, compared with 39,009 in the previous season; about 90 per cent. of this represents native production. Reports received from the Experiment Stations and multiplication areas maintained with the assistance of a grant from the Corporation indicate that much useful work is being accomplished. This work consists of trials of different varieties of cotton, which will be continued until the type best suited to each district has been established. In addition, spacing trials, manurial tests, and other similar experiments are in progress to determine the most suitable cultural conditions for the several districts. The introduction of mixed farming by natives on small holdings is being gradually and carefully extended. At the Experiment Station at Lubaga, in addition to regular experiments with cotton, attention is being devoted to the very important work of preventing soil erosion, which has been extremely serious in this district in the past. The Department of Agriculture record that the two ginnery inspectors generously provided by the British Cotton Growing Association have been very helpful, and both the ginning percentage and the quality of the outturn have been improved through their advice.

556. *New Transport Unit.* (*Crown Colonist*, June, 1936, p. 283.) The 15-ton transport unit, which has been obtained by means of a £5,000 grant from the Colonial Development Fund, has been undergoing trials in the vicinity of Dar-es-Salaam and in Lake Province. The unit consists of an eight-wheeled 130 h.p. tractor, driven by heavy fuel oil, and two eight-wheeled trailers on bogies, the total length being 74 ft. The first tests gave promise that it would fulfil the demands to be made upon it in opening up districts where it would be too expensive to construct feeder railways, and such areas may thus be supplied with transport services at rates near to the low level of railway rates.

557. UGANDA : *Cotton Industry, 1935-36.* The report for June, received from the Dept. of Agriculture, gives the cotton crop for the season as 318,000 bales, which constitutes a record for the country. Weather conditions were generally favourable for the 1936-37 crop, and increased acreage was being planted in most areas.

558. *Cotton Industry, 1935-36.* (*Crown Colonist*, July, 1936, p. 326.) The crop is stated to be 320,000 bales, which is easily a record for the country. This makes Uganda the second largest cotton-producing country in the British Empire, being second only to India. Government has issued a warning to ginneries to prepare for a 20 per cent. increase in crop next year, and to commence to erect additional storage accommodation.

559. THE UGANDA COTTON SEASON. By J. Marston. (*Crown Colonist*, May, 1936, p. 213.) A brief sketch of the opening of the cotton buying season in Uganda.

560. AUSTRALASIA. QUEENSLAND: *Cotton Industry*, 1935-36. (*Queensl. nd Agr. J.*, June, 1936, p. 601.) The report for June states that cotton harvesting has proceeded throughout the month, and during the period rain has fallen over most of the cotton areas, generally in small amounts. Insect damage continues to be severe, especially on late-planted cotton, and it is not anticipated that the crop will yield as much as was expected. Receivals at the ginneries are good, and the quality of the cotton is being maintained. No frosts of sufficient intensity to kill the cotton bushes have yet been reported.

561. Cotton Cultivation. From the *Int. Cott. Bulletin*, vol. xiv., No. 55 of April of this year we give the following extracts: "An article published under the Cotton Growing Section, p. 565, of the *Int. Cott. Bull.*, No. 52, July, 1935, contained some points which are now stated to be inaccurate by the General Manager of the Queensland Cotton Board. (Cf. Abstr. 31, of the current volume of this Review.) The article in question was extracted from a reliable source, and was republished in good faith. Mr. R. J. Webster, General Manager of the Queensland Cotton Board, has written to this office, under date February 28, 1936, to correct these inaccuracies. The following extracts are taken from his letter: 'Durango will not soon be the standard cotton of Australia—in fact the growing of this variety has been abandoned almost completely, and probably by next year there will be no Durango at all in the State. The costs of production, too, are very much over-stated. Whatever may have been the case some years ago, the average cost of production is now certainly not anything like 3d. per lb. of seed cotton, nor is the picking charge 1½d. per lb. of seed cotton. Last year the rates were fixed at 10s. 6d. per 100 lb. of seed cotton. . . . In connection with ginning costs . . . you quote this as 1·125d. per lb. of seed cotton; in actual fact it was ·12d. per lb. of seed cotton for the 1934 season, and ·13d. per lb. for the 1935 season.' "

562. CONSIGNMENT OF COTTON. By W. G. Wells. (*Queensland Agr. J.*, xlv., 3, 1936, p. 263.) Warnings are given against various practices that tend to lower the value of Queensland cotton: e.g., packing too much into a bale to save transport—this tight packing rendering cleaning of the cotton difficult—picking the cotton after a storm before fully dry, packing without grading, and using dirty containers. Woolpacks are recommended for packing the cotton, and the variety of cotton and the name and address of the grower should be stencilled on the container.

563. FIJI: *Sea Island Cotton*. (*Trop. Agr.*, xiii., 7, 1936, p. 188.) The extension of the Sea Island Cotton industry in Fiji has recently been under consideration. The Government of Fiji has undertaken to restrict production to an annual quota of 300 bales of 400 lb. each for a period of five years, 1937-41.

564. WEST INDIES. COTTON PRODUCTION, 1935-36. (*Crown Colonist*, June, 1936, p. 287.) An area of approximately 12,700 acres was planted to Sea Island cotton in the 1935-36 season, and the yield is estimated at 1,876,000 lb. of lint. In the previous season 8,067 acres were planted, and the total production was 1,464,621 lb. of lint. The production of Marie Galante cotton is estimated at 341,000 lb. lint as compared with 423,205 lb. lint in the 1934-35 season.

565. THE COTTON INDUSTRY, 1935-36. (*Trop. Agr.*, xiii., 7, 1936, p. 187.)

Antigua. The crop is estimated at 265 bales of 400 lb.

Barbados. Very little cotton was planted and the crop amounted to only 25 bales of 400 lb.

Nevis-Anguilla. The crop of the former is estimated at 465 bales and the latter 75 bales.

St. Vincent. Abnormally dry weather shortened the crop and reduced the yield from late planted cotton. The total crop is estimated at 900 bales, and is the largest produced since 1926.

Virgin Islands. The Sea Island cotton industry has been resuscitated on a small scale in these islands, and the final estimate of the first planting (1935-36) is 125 bales of 400 lb. Unfortunately the crop in Virgin Gorda was completely ruined by pink bollworm.

566. ST. KITTS-NEVIS: *Cotton Crop*, 1935-36. (*W. Ind. Comm. Circ.*, li., **983**, 1936, p. 246.) Nevis planted 2,000 acres in cotton, and St. Kitts only 1,000 acres, but the yield in each case approximated 200,000 lb. of lint. St. Kitts producing 200 lb. per acre as against Nevis's 100 lb. per acre. Anguilla planted 400 acres, producing 26,000 lb. lint, or 65 lb. per acre.

COTTON IN EGYPT.

567. EGYPTIAN COTTON CROP: YIELD. (*M/c. Guar. Coml.*, **32**, 1936, p. 541. From *Summ. of Curr. Lit.*, xvi., **11**, 1936, p. 352.) The Egyptian cotton crop of 1935-36 amounted to a total of 8,342,398 kantars (about 1,600,000 bales of 500 lb.) The production figure divided by the acreage gives an average yield of 5 kantars per feddan (nearly one bale per acre). The gross value of the total crop (leaving sowing seed out of account) works out at approximately £F25,250,000, which represents roughly £E15 on an average for every acre planted to cotton. This figure compares with £E11½ per acre in 1934-35, £E10½ in 1933-34, and £E11 in 1932-33. The total acreage for 1936-37 is expected to be some 6-8 per cent. larger than that for 1935-36. It is generally believed that the area under Sakellaridis has been approximately halved, that Maarad and Fouadi acreage is also appreciably smaller than last year, but that Giza 7 plantings have increased 50-60 per cent. Figures for the areas under the different varieties and the probable productions are given. The new varieties Giza 12 and 26 are expected to enjoy increasing popularity. Nahda has been virtually eliminated from cultivation this year and plantings of Casulli are insignificant.

568. EXPERIMENTS IN EGYPT ON THE INTERACTION OF FACTORS IN CROP GROWTH. By F. Crowther. (*Bull. No. 24, Tech. Sec. Roy. Agr. Soc., Egypt*, 1936.)

2A. *Residual Effects of Nitrogenous Manuring and Spacing of the Cotton Crop on the following Wheat Crop.*

2B. *Inter-relation of Nitrogenous Manuring, Variety and Spacing for the Wheat Crop.* Describes two experiments carried out at the Society's farm at Bahtim in 1934-35. The results indicate that the present close spacing of cotton, which is considered desirable in Egypt, exhausts the food supplies in the soil more than in the past, and consequently lower yields are obtained from the wheat crop following. This can be counteracted by heavier manuring of the wheat crop. The author also shows that nitrogenous fertilizers are not washed out of the soil as easily as was earlier believed. The bulletin is not intended as a practical manual for cultivators, but describes observations made on the growing crop which are of technical interest in explaining yield differences.

COTTON IN THE UNITED STATES.

569. THE AMERICAN COTTON CROP. By A. F. W. Coulson. (*Text. Wkly.*, xvii., **432**, 1936, p. 677.) The recent developments in production methods are discussed under the headings of: Cotton breeding; Planting and cultivation; Cotton harvesting; Cotton ginning. "A vast educational programme for planters, farmers and ginners is carried out by the U.S. Government. This work is done

by field officers of the Dept. of Agriculture, by pamphlets, and by weekly talks over the wireless, termed 'Radio Farm Flashes.' In these talks, expert agronomists, classifiers, and physicists inform planters and ginnermen of the latest results obtained from tests carried out in their laboratories. Much valuable practical information is also given regarding best gin practices, the best sowing and harvesting dates, and the state of the cotton crop generally."

570. AMERICAN COTTON INDUSTRY: EQUIPMENT, OPERATION AND MARKET. By W. R. Bell. (*Cotton. U.S.*, 100, 4, 1936, p. 76. From *Summ. of Curr. Lit.*, xvi., 13, 1936, p. 391.) A table showing details of equipment, operation and market conditions in the American cotton industry for the years 1926-1935 is given and discussed. During 1935 there was a decrease of 1,636,040 spindles, or about 5½ per cent. of the total installation, the most severe contraction of equipment yet experienced in any single year. Idle spindleage during 1935 varied from 5,680,000 in January to 7,968,000 in August. Over 4,000,000 spindles did not operate at all during the year, an increase of about 1,000,000 over the 1934 record. The working industry during 1935 was represented by 23,421,150 spindles, which is the average of those reported as active in each of the twelve monthly reports. The hours run by each average active spindle during the year amounted to 3,246, a figure slightly higher than that for 1934. Production solely for domestic requirements in 1935 is estimated at about 90 million square yards greater than in 1934, but 850 million square yards less than in 1933. Export volume dropped to a new low yardage, being 25 per cent. less than the previous year. Imports increased by about 50 per cent. to the highest yardage in the past ten years.

571. THE UNITED STATES GOVERNMENT AND COTTON: EFFECT OF ACTIVITIES ON THE INDUSTRY. By Alston H. Garside. (*Text. Wkly.*, xvii., 435, 1936, p. 471.) In an address to the Atlantic Cotton Association, South Carolina, Mr. Garside, the Economist of the New York Cotton Exchange, stated that "if the United States Government adopts a scientific soil-building programme under the new Soil Conservation Law, and applies it boldly to cotton growing, leaving it to growers to produce crops approaching in size those formerly grown, and if it does not retard the flow of American cotton to world markets by price-supporting loans, the cotton-growing industry of the United States and the South generally will head for unprecedented prosperity."

After reviewing the work of the U.S. Government he says: "First of all, these Government activities have demonstrated that it is utterly beyond the power of the Government to raise the world price of cotton, either by assisting growers in withholding supplies from market or by curtailing production of cotton in America, except to the extent of a few cents a pound for a very brief period, pending the inevitable increase of acreage and production outside the United States. . . . Secondly, Government activities in cotton in recent years have shown that the only way by which the United States can raise the world price even temporarily is by cutting down the American cotton-growing industry and surrendering a portion of the market for American cotton to foreign producers. . . . Thirdly, the movement of the price of cotton during the last three years, while the Government has been bringing about curtailment of production, demonstrates—especially if allowance is made for the effect of devaluation of the dollar—that such temporary increase in the price per pound as may be brought about by such drastic decrease of production as the United States has effected in these three years is not enough to increase materially, if at all, the growers' net income, since most or all of what the growers gain in added price per pound they lose by reduction of the number of pounds which they have for sale. . . . Fourthly, cotton trade developments which have followed lending operations by the U.S. Government demonstrate that, when a substantial portion of the American cotton crop is

withheld from market, even for a few months, by such methods as Government loans at or near current price levels, a large portion of the market for such withheld cotton is lost to outside growths, and the impounded cotton subsequently acts as a depressant to prices."

After discussing the new soil conservation movement, the author concludes: "I can visualize the south averaging, within a few years, say 200 to 225 lb. of cotton to the acre, planting enough acreage with that yield to make 14,000,000 to 15,000,000 bales of cotton."

572. AMERICAN COTTON BALES: PACKING. (*Cotton. M/c.*, **12**, 2104, 1936, p. 4. From *Summ. of Curr. Lit.*, xvi., **11**, 1936, p. 295.) Statements of the U.S. Principal Marketing Specialist with reference to spinners' complaints concerning "false-packed" and plated bales are reported. The significance in America of the terms "false-packed" and "mixed-packed" or "two-sided" bales is emphasized. Shippers are advised to sample both sides of the bale. "False-packed" bales contain inferior cotton inside with better cotton on both sides, and are illegal in most States, but the occurrence of "mixed" packs is governed by weather conditions and therefore likely to persist.

573. THE NUMBER OF COTTON FARMS IN U.S.A. (*Int. Cott. Bull.*, xiv., **55**, 1936, p. 299.) The 1935 census shows that as a result of cotton acreage control laws and the activity of Government relief agencies during the past two years, the number of cotton farms decreased slightly more than 3 per cent., and cotton acreage decreased approximately 39 per cent. compared with the number of farms and acreage to cotton reported by the 1930 census. The 1930 census shows that 1,986,591 farms planted 43,225,876 acres to cotton, compared with 1,919,566 farms and 26,782,469 acres reported by the 1935 census. Cotton acreage per farm dropped from an average of 21 acres in 1930 to 13 acres in 1935. The decrease in the number of farms planting cotton was probably due to drought and to the migration of tenant farmers to Government relief projects. It is interesting to note that during the period under review (1930-35) there was an increase in the number of cotton farms in South Carolina, Tennessee, Missouri and Oklahoma.

574. RESEARCH WITH FIELD CROPS IN THE BUREAU OF PLANT INDUSTRY. (*U.S. Dpt. Agr., Bur. Plant Indus. Rpt.*, 1935. From *Exp. Sta. Rec.*, **74**, **5**, 1936, p. 625.) Brief reviews are given on the progress of the breeding work with various crops, including cotton; varietal studies with cotton and soybeans; and experiments in community production of cotton.

575. ARIZONA: The Quality of Arizona Cotton. By R. L. Matlock and J. R. Kennedy. (*Arizona Sta. Bull.*, **150**, 1935. From *Exp. Sta. Rec.*, **74**, **4**, 1936, p. 560.) Arizona had a higher proportion of cotton classed Good Middling and above during the six-year period, 1928-33, than the United States as a whole, but less than New Mexico or California. Spotted and other coloured cotton averaged about 15 per cent. of the Arizona crop compared with 20.2 per cent. in New Mexico, 3.6 per cent. in California, and 15.5 per cent. for the United States as a whole. Since 1928 there has been a definite trend in Arizona towards an increased percentage of cotton classed as $1\frac{1}{8}$ and $1\frac{3}{8}$ inch, and more than 35 per cent. of Arizona's Upland cotton for the six-year period was classed as these lengths, compared with 11.5 per cent. for the United States as a whole.

576. ARKANSAS: Agronomic Research in 1935. By M. Nelson *et al.* (*Arkansas Sta. Bull.*, **323**, 1935. From *Exp. Sta. Rec.*, **74**, **6**, 1936, p. 771.) The work with cotton included: variety trials; breeding experiments; genetic studies; fertilizer trials; study of the relation of soil type to cotton yields; interplanting of legumes in corn and effects on yields of the succeeding cotton crop; cotton fibre investigations, including analysis of variance of halo length in cotton, studies

on samples satisfactory for single fibre strength tests, length-diameter, relationship of cotton fibre, and fibre analyses from wilt variety, wilt-fertilizer and variety and strains tests; study of efficiency of single and double restriction in randomized field trials with cotton. The cotton fertilizer studies dealt with formulas for different sections, rates of application, placement, home v. factory mixed, and nitrogen carriers.

577. OKLAHOMA: *Relative Economic Advantages of Harvesting Cotton by Picking and Snapping in Western Oklahoma.* By C. C. McWhorter and R. A. Ballinger. (*Oklahoma Sta. Bull.*, 227, 1935. From *Exp. Sta. Rec.*, 74, 4, 1936, p. 556.) Picked cotton averaged higher in grade and longer in staple during 1932-33 and 1933-34 than snapped. Because of the extra weight of foreign matter it required from 450 to 500 lb. more seed cotton harvested by snapping than picked cotton to make a standard sized bale.

In 1932-33 it cost on the average 43 ct. per bale more to harvest enough cotton to gin a 500 lb. bale of lint by picking than it did by snapping, but it cost \$2.26 more to gin the snapped than the picked cotton, making the net cost \$1.83 per bale more for snapped cotton. However, in 1933-34 the cost of harvesting picked cotton was \$1.66 per standard sized bale more than the cost for snapped cotton, while the cost for ginning the snapped cotton was only \$1.38 more per bale, so that there was a net cost of 28 ct. per bale more for the picked cotton. This changed situation was caused by an increased spread between the cost of harvesting picked and snapped cotton, and a narrower spread between the costs of ginning in 1933-34 than in 1932-33. An analysis of the prices received by farmers for picked and snapped cotton shows that on most days during each season studied local prices were higher for picked than for snapped cotton.

Although the data in this study show that it was generally more profitable to harvest cotton by picking than by snapping, other factors may be of some importance in modifying these results. Cotton can be harvested more rapidly by snapping than by picking. Snapping enables a smaller labour force to harvest a given amount of cotton and to get the work done with less danger of weather damage to the cotton.

COTTON IN FOREIGN COUNTRIES.

578. ARGENTINA: *Cotton Production.* (*Cotton, M/c.*, 4/7/36.) It is estimated that the total output for 1935-36 will amount to 240,000 bales. A survey just completed reveals that Argentina now has a total of 788,000 acres under cotton. The Chaco territory, with 631,000 acres in cotton, is the most important single area, but efforts of the Cotton Board to encourage planting in other Northern provinces have proved successful.

In the 1934-35 season, of the total of 64,100 tons produced, approximately 57 per cent., or 36,500 tons, with a value of \$10,000,000, was shipped abroad. Domestic consumption of cotton has shown a steady increase, and efforts are being made to open up new foreign markets to absorb the rapidly growing production.

579. Boletín Informativo. (Pubd. by Min. of Agr. Junta Nacional del Algodón, Buenos Aires, Argentina.) We have recently received copies of this bulletin. It is a monthly publication which should be of much value to cotton growers in Argentina, containing as it does notes on all matters of local interest, such as ministerial visits, opening of agencies, Government regulations, co-operative credit, meetings of the National Cotton Committee, etc. It should also be of interest to those in other countries by virtue of its figures for acreage, production, exports, and prices.

580. *Memoria de la Junta Nacional del Algodon, Mayo-Diciembre de 1935.* (Min. de Agr. de la Nacion, Republica Argentina, Buenos Aires, 1936.) A description of the work of the National Committee for Cotton in Argentina. It is divided among five sub-committees, which deal with: (1) Experiment stations; (2) Acquisition and selection of seed; (3) Land and colonization; (4) Ginning; (5) Commerce and standards. The work of each of these branches is described in detail, and an appendix is included giving the Government orders and regulations.

581. BELGIAN CONGO: *Cotton Industry.* The report of the Compagnie Cotonnière Congolaise for the year 1935 states that cotton production has increased from 30,600 tons in 1930 to 77,500 tons in 1935, and it is anticipated that the yield in 1936 will be 85,000 tons. There are at present 75 ginneries in the country. The prospects of the industry are good.

582. BRAZIL: *Algodão.* We have received a copy of this journal for April, 1936. It contains, among other matters, various articles (in Portuguese) dealing with the following: The appearance of *Fusarium rasilsectum* wilt in Brazil; a new Braconid parasite of the bollworm; botany of the cotton plant; the cottonseed oil industry in Minas Geraes; cotton in the state of Matto Grosso; cultivation of cotton in the state of São Paulo.

583. CHINA: *Cotton Production, 1935-36* (*Cotton, M/c.*, 4, i/36.) A crop of some 3,000,000 bales is expected this year, compared with 2,600,000 bales in 1935. China is one of the leading cotton producing and consuming countries of the world, ranking third in production and fifth in consumption. Over a period of ten years, according to the U.S. Dept. of Agriculture, China has furnished an export market for approximately 300,000 bales of American cotton annually. Since 1931-32, however, when export of American cotton to China amounted to 1,112,000 bales, the trend has been downward, and in 1934-35 exports of American cotton to that country amounted to only 108,000 bales.

584. ASSOCIATION COTONNIÈRE COLONIALE. *Bull. No. 21, 1936*, contains the following papers: "La reprise de la culture du coton en Afrique du Nord sur des données nouvelles"—a letter pointing out errors in a paper under this title that appeared in June 1935; "Les services agricoles et de recherches scientifiques en A.O.F."; "Il importe d'intensifier la culture du coton au Senegal, ou elle est très ancienne, ainsi qu'au Soudan"; "Situation des plantations de coton aux États-Unis," etc. The usual notes on cotton in the French Colonies and other cotton-growing countries, cotton legislation, marketing, etc., are included.

585. FRENCH TEXTILE INDUSTRY: VERTICAL ORGANIZATION AND TAX ON VOLUME OF BUSINESS. By B. Thierry-Mieg. (*Bull. Soc. Ind. Mulhouse*, 102, 1936, p. 117. From *Summ. of Curr. Lit.*, xvi., 10, 1936, p. 292.) The advantages and disadvantages of vertical organization in the cotton industry are discussed, and it is concluded that the growth of vertical concerns has, on the whole, had an unfortunate influence on the French textile industry. It is pointed out that the tax on volume of business is largely responsible for the present state of affairs, and various alternatives that have been suggested at different times, such as a tax on the last sale, a tax on imported cotton, or a tax on added value, are discussed. The need for reform of the present system is emphasized, and the setting up of a commission of three to study conditions and methods is suggested.

586. GREECE: *Cotton Industry.* (*Text. Rec.*, liv., 669, 1936, p. 69.) Cotton production for 1935 was estimated at 34-35,000,000 lb., a very large increase over the previous year. Consumption of cotton in Greece is about 40,000,000 lb. annually, so that approximately 85 per cent. of the home market was last year served by home production. In 1934 local production was sufficient for only about 66 per cent. of the home demand. This development of the industry is to

a great extent accounted for by the tariff and quota restrictions placed by the Greek Government on imports of both raw and manufactured cotton. It is interesting to note that last year, for the first time, Greece exported cotton, some 2,100,000 lb. going to Germany.

587. COTTON CULTIVATION IN IRAQ. By G. Fürbringer. (*Wirtschaftsdienst*, 21, 1936, p. 659. From *Summ. of Curr. Lit.*, xvi., 11, 1936, p. 293.) A brief description of the developments, actual and prospective, of roads and railways around Iraq. Data concerning imports and exports are given. The cotton crop in 1926 was 5,200 bales, but in 1933 it had sunk to 500 bales only. Research into the reasons for this have resulted in more suitable strains being cultivated, and the crop in 1936 reached 5,000 bales.

588. JAPANESE COTTON GOODS: COMPETITIVE POWER. By H. Krause. (*Wirtschaftsdienst*, 21, 1936, p. 801. From *Summ. of Curr. Lit.*, xvi., 13, 1936, p. 392.) The question whether Japan can lower the price of textiles still further is discussed, and the conclusion is drawn that Japanese prices have not reached their lowest level of profit.

589. JAPANESE TEXTILE INDUSTRY: STATISTICS. By H. Sobuc. (*J. Soc. Chem. Ind. Japan*, 39, 1936, 44B. From *Summ. of Curr. Lit.*, xvi., 10, 1936, p. 292.) Statistics of imports of raw cotton and wool and exports of raw silk and manufactures are provided.

590. PERUVIAN COTTON: EXPORT. By K. Pritzkolet. (*Wirtschaftsdienst*, 21, 1936, p. 657. From *Summ. of Curr. Lit.*, xvi., 11, 1936, p. 296.) The imports and exports of Peru during the last eleven months are analyzed and discussed, as is also the growth of industrialism there. Attention is drawn to the large increase in cotton exports, and to the fact that Germany and Japan have now become larger customers for Peruvian cotton than England. Tables of figures illustrate this point.

591. COTTON: CULTIVATION IN SPAIN. By E. Martinez de Bujanda. (*Int. Rev. Agr.*, 27, 1936, E60. From *Summ. of Curr. Lit.*, xvi., 9, 1936, p. 230.) A general review of post-war developments, and especially of the work of the State Cotton Commission and its successor, the Institute for the Promotion of Cotton Growing.

592. COTTON CULTIVATION IN SYRIA. By G. Fürbringer. (*Wirtschaftsdienst*, 21, 1936, p. 518. From *Summ. of Curr. Lit.*, xvi., 9, 1936, p. 230.) Cotton cultivation in the neighbourhood of Damascus and Aleppo has improved since 1924, and now covers about 30,000 hectares. The yield of lint in 1934 was about 2,800 tons, of which Germany bought 550 tons. The most suitable variety is Texas Lone Star; the native Baladi is grown on only one-third of the area.

SOILS AND MANURES.

593. SOIL RESEARCH IN THE BRITISH EMPIRE PUBLISHED DURING 1935. (Pubd. by Imp. Bur. of Soil Sci., Harpenden, England, 1936.) This brief summary—the first of an annual series—is issued in place of *Publications of Soil Science Issued from the Empire Overseas*, which is thought to have outlived its purpose. The summary does not refer to every paper published during 1935, nor necessarily to every “important” paper, though most of these have been included. The aim has been as much to indicate the main directions in which soil science is developing in the different countries as to record outstanding results, which must naturally be few within any single year. At the same time, as much factual information as possible is included without making the pamphlet too cumbersome.

594. SOILS: THEIR ORIGIN, CONSTITUTION, AND CLASSIFICATION. By G. W. Robinson. (T. Murby and Co., London, 1936. 2nd edition. Price, 20s. From *Trop. Agriculture*, xiii., 5, 1936, p. 136.) The fact that a new edition of Professor G. W. Robinson's book is already demanded indicates the need for a book of the scope of this one, and the great success of its author's efforts to meet that need. The new edition differs from the first (*Cf. Abstr. 548*, Vol. X. of this Review) in that the subject-matter has been extended by some 60 pages, and the list of references by 150 additional entries. Certain statements and explanations have been clarified, and parts of the text have been amended in view of recent advances in the science of the soil, notably the discussions of pedogenic processes, the clay complex, base exchange, soil moisture and soil classification. Professor Robinson's book records his own view of pedology, and is "not intended to be an impersonal and impartial account"; it is a "picture rather than a photograph," and the facts have been arranged so as to present the author's particular perspective. Since Professor Robinson's long experience and philosophic interests cover a very wide field, embracing both geological, geographical and agricultural aspects of the soil, and since his reputation is international, students would be well advised to trust to his guidance.

595. SOME PLANT AND SOIL-MOISTURE RELATIONS. By F. J. Veihmeyer and A. H. Hendrickson. (*Amer. Soil Survey Assoc. Bull.* 15, 1934, p. 76. From *Exp. Sta. Rec.*, 74, 4, 1936, p. 458.) An investigation reported from the University of California has yielded data showing the constancy of the permanent wilting percentage under widely different evaporating conditions.

596. NITROGEN BALANCE IN BLACK COTTON SOILS IN THE MALWA PLATEAU. II. CHANGES DURING THE HOT WEATHER. By Y. D. Wad and R. K. Aurangbadkar. (*Ind. J. Agr. Sci.*, vi., 11, 1936, p. 316.) *Summary.* The nitrogen changes occurring in wet and dry soils, manured and unmanured, were estimated at high temperatures with low and high humidities, in sunlight and in shade. The relative predominance of factors involved was estimated. The results were statistically evaluated. Results with sterile soils indicated the predominance of biological action, but gave no significant evidence of photo-oxidation. The possibility of the accumulation of soil-nitrates by normal micro-organic activity under very drastic conditions is discussed. Rise in temperature, whether due to direct sunlight or otherwise, and in moisture, intensified nitrification. Nitrogen losses occurred during these experiments with different intensities. The all-round favourable influence of compost both on the oxidation and conservation of nitrogen under varied surroundings is emphasized. Both compost and ammonium sulphate improved soil texture, but the effect on moisture conservation was not the same. The soil processes seem to be affected less by external surroundings than by the properties of the soil-complex, which, however, undergoes continuous modification both by the duration of nitro-organic activity and by changes in environment. It is suggested that a sound basis for improvements in soil management will be available when accurate information is secured regarding the existing balance in a locality between the several active factors and the limits to their control.

[*Cf. Abstr. 223*, Vol. XI. of this Review.]

597. METHODS FOR REDUCING THE RETAIL COST OF COTTON FERTILIZERS. By W. H. Ross and A. L. Mehring. (*Yearbook Com. Fert.*, 1935. From *Exp. Sta. Rec.*, 74, 5, 1936, p. 610.) Data are presented showing: "(1) that for most of the cotton-producing States the saving to the farmer by the elimination of filler is about the same as though the wholesale cost of phosphoric acid were cut in half; (2) that the saving to the farmer in the reduction of the wholesale price of potash in a 3-9-4 mixture would be less than half of that for a corresponding reduction

in the wholesale price of either nitrogen or phosphoric acid; (3) that the combined saving in the elimination of organic nitrogen and of side dressing, where either change does not interfere with the efficiency of the fertilizer, amounts to more than if the wholesale cost of either nitrogen or phosphoric acid and potash were cut in half; and (4) that the farmer who uses double-strength fertilizers makes more than twice as great a saving in his fertilizer bill as would be possible from . . . any one of the other single methods for effecting a saving in the retail cost of fertilizers. It is recognized that the price of double-strength goods is limited at present, and that the price might advance for a time with a greatly increased demand for fertilizers of this kind. There would be no justification, however, for accompanying an increase in the analysis of fertilizers because of the elimination of filler, with a rise in retail costs. A marked reduction in the retail cost of fertilizers thus seems possible apart from that which would result from a decrease in the cost of producing nitrogen, phosphoric acid, or potash."

598. EFFECTS OF PARTICLE SIZE ON THE PROPERTIES AND EFFICIENCY OF FERTILIZERS. By A. L. Mehring *et al.* (*U.S. Dpt. Agr. Tech. Bull.* 485, 1935. From *Exp. Sta. Rec.*, 74, 5, 1936, p. 607.) The authors report from the Bureau of Chemistry and Soils a study of the effects of particle size on the properties and behaviour of fertilizers during preparation and use. In the field tests non-segregating fertilizers with grains ranging in fineness from that of a 2- to 3-mesh grade to that of an 80- to 150-mesh grade, and dry-mixed fertilizers with the superphosphate particles only varying in size, were applied accurately and uniformly to cotton in three soil types for three seasons. Of the grained fertilizers, from 80- to 150-mesh particles produced the highest yields in a majority of the thirteen trials. The smallest superphosphate particles were the most effective in every test, and the average difference in yield as between the smallest and largest particles was more than enough to pay for all of the fertilizer used. Chemical analyses of the soil to which the fertilizers had been applied were made to determine the differences in the rate of leaching and changes in solubility of the fertilizer elements, and laboratory tests were made to determine the present range of particle size in typical fertilizers and the effects of particle size on various properties of fertilizers, and their behaviour during handling and distribution. The most efficient particle size under average circumstances was found to be that of an 80- to 150-mesh grade, the criteria used for determining relative efficiencies having been stand counts and yields of seed cotton.

599. RESIDUAL EFFECT OF POTASH ON COTTON. By H. P. Cooper and R. W. Wallace. (*48th Ann. Rpt. S. Car. Exp. Sta.*, 1935, p. 124.) In an experiment started in 1932, muriate of potash was applied broadcast at the rates of 100, 200, and 400 lb. per acre. There were two plots of each treatment. 600 lb. of a 7-5-10-0 is applied annually to all plots, but no additional potash has been applied since 1932. The soil type was Norfolk sandy loam to Portsmouth sandy loam. Results from a 3-year average, 1932-1934 inclusive, show there was an increase of 44.1, 75.2, and 87.8 per cent. from 100, 200, and 400 lb. of muriate per acre respectively over no-potash.

600. A COMPARISON OF WINTER LEGUME GREEN MANURE AND NITRATE OF SODA FOR FERTILIZING COTTON. By G. A. Hale. (*J. Amer. Soc. Agron.*, 28, 2, 1936, p. 156. From *Exp. Sta. Rec.*, 74, 6, 1936, p. 774.) Winter legume green manure, sodium nitrate, and a combination of green manure and sodium nitrate were compared for fertilizing cotton during eight years on Cecil sandy loam at the Georgia Experiment Station. Green manure of hairy vetch and Austrian winter peas turned under two weeks before planting cotton resulted in slightly larger yields than 100 lb. per acre of sodium nitrate applied at planting. Average yields of seed cotton resulting from 200 lb. per acre of sodium nitrate amounted

to 1,154 lb. compared with 1,044 lb. from winter legume green manure. Supplementing the green manure with 100 and 200 lb. of sodium nitrate per acre increased yields over green manure alone. Slightly better stands, as shown by total number of plants and hills per acre at picking, were observed on the green manure and sodium nitrate alone treatments than where both were used.

601. THE LATEST METHODS OF SILAGE-MAKING. By P. D. Henning. (*Farmg. in S. Afr.*, xi., **122**, 1936, p. 199.) Deals with the principles of silage-making, the methods of ensiling, the role of bacteria, enzyme action, and the importance of rapid lactic-acid fermentation. Experiments in silage-making carried out at Stellenbosch College of Agriculture, South Africa, are described.

602. SILAGE AND SILOS. (*Rhod. Agr. J.*, June, 1936, p. 442.) Gives the approximate weight of silage that can be contained in cylindrical, square, and trench silos of different sizes.

603. A COMPILATION OF EXPERIMENTAL DATA ON COTTON FERTILIZERS APPLICABLE TO THE HILL SECTIONS OF MISSISSIPPI. Compiled by C. F. Clark. (*Miss. Sta. Bull.* 309, 1935. From *Exp. Sta. Rec.*, 74, **6**, 1936, p. 774.) The information covers amount of nitrogen, phosphorus, and potash to apply per acre; low analysis v. high analysis fertilizer; factory-mixed v. home-mixed fertilizer; sources of nitrogen, phosphorus, and potash for cotton; organic v. inorganic nitrogen sources; and time of applying sodium nitrate to cotton.

604. SOIL EROSION. By E. Fischer. (*Farmg. in S. Afr.*, xi., **123**, 1936, p. 240.) Discusses the causes of soil erosion, and suggests control by preservation of vegetation, avoidance of overstocking on vulnerable lands, and improved cultural methods.

605. SOIL EROSION ON CULTIVATED LANDS. By K. E. W. Penzhorn. (*Farmg. in S. Afr.*, xi., **123**, 1936, p. 251.) Deals with the evils of soil erosion in South Africa, and the value of contour drains as a method of control.

606. WASTE BY WIND AND WATER. By H. H. Bennett. (*The Ecby. Sci. Mnthly. From Trop. Agr.*, lxxxvi., **5**, 1936, p. 294.) Discusses the tremendously important problem of soil erosion in the United States, and what is being done by the Soil Conservation Service to deal with it.

607. A DEVICE FOR MEASURING PRECIPITATION WATERS LOST FROM THE SOIL AS SURFACE RUN-OFF, PERCOLATION, EVAPORATION, AND TRANSPIRATION. By G. W. Musgrave. (*Soil Sci.*, 40, **5**, 1935, p. 391. From *Exp. Sta. Rec.*, 74, **4**, 1936, p. 458.) A description of the device, with working drawings and photographs of various stages in the construction and manipulation.

CULTIVATION, IRRIGATION, GINNING, ETC.

608. LAND AND LAND USE. By P. E. Brown. (*Sci.*, **83**, April, 1936, p. 337.) Chiefly referring to the United States. Exploitation was the rule till the depression began; now erosion-control and other land-saving movements are in full swing. About 45 per cent. of the land is really unsuitable for tillage; the Government is proposing to begin to remove sub-marginal land from production. Proper use of the remainder is needed. The peak population is expected to be about 140 millions, and it needs about 1.9 acres to feed, and 0.2 acre to clothe and otherwise provide for the average American. The relations of land to proper taxation also require careful study; it is considered that land at present is taxed much too highly.

609. MIXED FARMING IN EAST AFRICA. By G. R. Morrison. (*East Africa*, London, 1935. Price 12s. 6d. Reviewed in *E. Afr. Agr. Jour.*, i., **6**, 1936, p. 435.)

From this review we quote the following: "The scope of the book can be simply stated. The author's 'East Africa' consists of well-watered land at moderate to high elevation, near a railway and a local market for produce, and from which the native African as a stockholder has been excluded. Given these conditions, the principles of intensive management are developed that should be followed by the small farmer who intends to settle about 300-500 acres of land and run it himself. There is an admirable chapter on 'the lessons of the past,' which is a reasonable but none the less severe condemnation of speculative farming, of one-crop farming, of the growing of low-value commodities, and of the failure to consider the small farm as an enterprise differing not only in scale from the large one. The same subjects are handled constructively in the remainder of the book, with sufficient practical detail from the author's own fifteen years' experience to give his discussions point and reality, whilst preserving the character of the whole as an essay rather than a textbook. Particular matters on which he is emphatic are paddocking and rotational grazing, the adoption of lines of production that will bring in a steady monthly cheque, tree-planting about the farm, whole-hearted loyalty to co-operation, and high feeding both of stock and of land. In such a critical discussion of internal farm policy as this is, politics external cannot, of course, escape being touched upon, but the necessary references are brief and are kept to their place.

"Mr. Morrison's timely and soundly informed book on the subject that matters more than any other just now to farmers in the highland areas, and to those advising them, cannot fail to have a wide sale to its public. In his introduction, he admits that 'anyone who attempts to write a book about farming stands to be shot at.' Doubtless many will have their shot, but the position is strongly defended. If the reviewer must have his, it will be to suggest that the somewhat limited possibilities of local markets have not been faced quite frankly. Upon the disposal of perishable produce mixed farming stands or falls, and in an East Africa (outside Mr. Morrison's white enclave) so slenderly populated with bacon and butter eaters, who is to buy?"

610. SUR LE CLIMAT DU COTON CULTIVÉ. By R. Musset. (*Revue de botanique appliquée et d'agriculture tropicale*, No. 162, 1936, p. 88. From *Coton et Cult. Coton*, x., 1, 1936, p. 45.) The author warns against the cultivation of cotton in regions where there is not sufficient interval between the first and last frosts.

611. STATISTICAL METHODS, WITH SPECIAL REFERENCE TO FIELD EXPERIMENTATION. By A. R. Saunders. (*Farmg. in S. Afr.*, xi., 122, 1936, p. 220.) A scientific bulletin issued by the Department of Agriculture and Forestry, written with the object of bringing together some of the recent but widely scattered data on experimental technique, with special reference to field experiments. A fairly extensive bibliography is included.

612. SOME CHEMICAL METHODS OF WEED DESTRUCTION. By H. C. Long and R. K. MacDowell. (Reprinted from *J. Roy. Agr. Soc.*, vol. xevi., 1935, p. 22. Price 6d., post free. Obtainable from H. C. Long, "The Birkins," Orchard Road, Hook, Surbiton.) Deals with weed destruction by spraying with sulphuric acid, sodium chlorate, calcium cyanamide and ammonium thio-cyanate, and also with spraying machinery.

613. ON THE PHYSIOLOGICAL CHARACTERISTIC OF COTTON IRRIGATION. By I. M. Vassiliev. (In Russian, with English summary.) (*Phys. Bioch. and Anat. of Plants*, Ser. III., No. 12, Inst. of Plant Ind., Lenin Acad. of Agr. Sci., 1935.) An account of experimental work carried out in 1930 at the Ak-Kavak Experimental Irrigation Station, Tashkent, to ascertain the effect on the life activity of the cotton plant of different forms of irrigation. This was tested by deter-

minations of osmotic pressure of the cell-sap, changes in water content of the leaves and dry matter, and behaviour of the stomata. The forms of irrigation studied included: one watering at bud formation; one additional watering at flowering; five waterings—one at bud formation, three at the flowering stage, and one during maturation.

614. RESEARCH WORK IN COTTON GINNING. By C. A. Bennett. (*Agr. Eng.*, 16, 10, 1935, p. 389. From *Exp. Sta. Rec.*, 74, 5, 1936, p. 707.) In a contribution from the U.S. Dpt. of Agr., Bureau of Agricultural Engineering, the organization, plan, and equipment of the research programme in cotton ginning in progress at Stoneville, Mississippi, in co-operation with the Mississippi Experiment Station, are described.

615. SINGLE ACTION GIN: EFFICIENCY. By Platt Bros. and Co., Ltd. (*Platt's Bull.*, 3, 1936, p. 434. From *Summ. of Curr. Lit.*, xvi., 11, 1936, p. 295.) Platt's Single-action Macarthy-type gin is reported from Egypt as having an output of 120 lb. of ginned cotton per hour. It shows an economy in oil consumption, replacement of parts, and does not require an adjuster. New models are fitted with ball- and roller-bearings. With these the average horse-power required per gin is reduced from 4.15 to 2.57.

616. DIESEL ENGINES: USE IN COTTON GINNTRIES. (*Times Trade and Eng. Suppl.*, 38, 865, xviii. From *Summ. of Curr. Lit.*, xvi., 8, 1936, p. 206.) In recent years the use of Diesel engines in ginneries has increased to an appreciable extent, and in many cases steam has been displaced. In an Egyptian ginnery the gins are driven through Texrope by a 7-cylinder 390 b.h.p. National engine, while a horizontal engine of the same make works the electrical generator through a rope drive. The engine has been running for 17 or 18 hours a day. The ginning season begins in September, and lasts for 5 or 6 months, with the engine working 7 days a week. The saving in fuel costs effected by the change from steam to oil power amounts to about £60 a week, or about £1,200 during a full ginning season.

617. QUALITY OF LINT IN RELATION TO GINNING FACTORS. Pt. I.: THE EFFECT OF (1) MOVING KNIFE SETTING; AND (2) SAW SPEED. By N. Ahmad and R. P. Richardson. (*Tech. Bull. Ser. A, No. 31*. Ind. Cent. Cott. Comm., 1936.) The bulletin describes the results of ginning tests on nine Indian cottons, ranging in staple length from 0.70 in. to 0.94 in. and in mean fibre-weight per inch from 0.109×10^{-6} oz. to 0.269×10^{-6} oz. Each cotton was divided into four lots; two lots were passed through a saw-gin with saw speeds of 325 r.p.m., and 425 r.p.m., the other two lots were passed through a roller-gin, the overlaps for the shorter cottons being $\frac{3}{8}$ in. and $\frac{1}{2}$ in. and those for the comparatively longer cottons $\frac{1}{4}$ in. and $\frac{5}{8}$ in. Each lot was tested for mean fibre-length and spun into two or three suitable counts, the yarns obtained being examined for breaking strength and neppiness. The mean fibre-weight per inch of each sample was determined and fibre-strength tests were made on the different lots of four cottons. From the experimental results the following conclusions are drawn:

The comparatively longer cottons gave a much higher outturn with the larger than with the smaller overlap. The difference between the outturns with the two overlaps diminished with the staple length of the cotton, and with the shortest cotton a higher outturn was obtained with the smaller overlap. The higher saw speed gave a significantly higher outturn in the case of all cottons except one. The difference between the outturns with the two speeds was independent of the staple length of the cotton, but the various cottons showed a differential response in this respect. For a majority of these cottons the greater

overlap gave higher ginning percentage. However, for cottons possessing a mean fibre-weight of nearly 0.150×10^{-6} oz. per inch, the reverse was found to be the case. The use of either of the two saw speeds did not make any appreciable difference to the ginning percentage in most cases. For the short and medium staple Indian cottons, an overlap of $\frac{3}{8}$ in. was found to be quite sufficient, while for the comparatively longer types, better fibre results were obtained with an overlap of $\frac{1}{2}$ in. The lower speed was found to be more beneficial from the point of view of staple length of the ginned cotton, especially in the case of the comparatively longer types. The values of the fibre-strength of these cottons were unaffected either by the overlaps or the speeds employed in these tests. The smaller of the two overlaps in the roller-gin and the lower speed in the saw-gin effected, on the whole, a greater degree of cleanliness, thereby giving rise to somewhat smaller waste losses in the blow-room. The differences between the card losses of the various lots of each cotton were insignificant. The number of yarn breakages in the ring frame were, on the whole, found to be fewer with the smaller than with the greater overlap, and with the higher than with the lower speed. On the whole, the lots ginned with the smaller overlap in the roller gin and the lower speed in the saw gin gave stronger yarns than the corresponding lots ginned with the greater overlap and the higher speed. This general statement, however, should be supplemented in each case by studying the individual response of the cottons to overlaps and speeds for which detailed results are given in the bulletin. The width of the overlap in the roller-gin and the speed of saws in the saw-gin, within the range employed in these tests, did not make any appreciable difference to the degree of yarn-neppiness in the case of a majority of these cottons.

PESTS, DISEASES, AND INJURIES, AND THEIR CONTROL.

618. NOTES ON LITTLE-KNOWN COTTON INSECTS. By J. W. Folsom. (*J. Econ. Ent.*, xxix., 2, 1936, p. 282.) The writer studied the feeding habits of many little-known cotton pests in the last season at Tallulah, Louisiana, and found that some species were of considerable economic importance since they destroyed large numbers of leaf buds and squares. Although the damage from any one of the species was usually not very extensive, the collective damage by all the species was sufficient to be important. Brief notes are included on the injury caused to cotton by thirteen species of *Coleoptera* and ten species of *Lepidoptera*.

619. CARTILLA PARA EL CULTIVO DEL ALGODONERO. (Min. de Agr. Junta Nacional del Algodon, Buenos Aires, Argentina, 1935.) A useful account, in Spanish, of methods of cotton cultivation and of the treatment of the more common pests. It is well furnished with coloured illustrations of all stages from the egg to the adult of the cotton leafworm (*Alabama argillacea*), American bollworm (*Heliothis obsoleta*), and pink bollworm (*Pectinophora gossypiella*).

620. SOUTHERN RHODESIA: *Cotton Pests in 1935*. By R. W. Jack. (*Ann. Rpt. of Div. of Ent.*, 1935.) The heavy invasion of the red locust towards the end of 1934 did not result in an outbreak of hoppers of any serious magnitude. This was due to the ravages of parasites and disease among the invading swarms, the locust fungus (*Empusa grylli*) being the most potent factor in this connection.

Many crops were badly affected by American bollworm, and in some cases the damage was very severe. Sudan bollworm was not in much evidence, but investigation of the pest at Gatooma goes to show that it may develop into a serious problem if the practice of ratooning cotton becomes general. As a result of drought stainer damage was less than usual, and little injury was caused by jassid.

621. REPORT OF THE CHIEF OF THE BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE, 1935. U.S. DEPT. OF AGRICULTURE. By L. A. Strong. (Washington, D. C., 1935. From *Rev. App. Ent.*, xxiv., Ser. A, 5, 1936, p. 291.) Tests for the control of boll weevil with dusts of thiodiphenylamine and sulphur, and with derris in inert carriers, gave promising results. Early morning applications of calcium arsenate were more efficient than those made at mid-day or in the evening. Equal parts of calcium arsenate and hydrated lime applied at the rate of 7 lb. per acre gave as good control as calcium arsenate alone at the same rate. Field inspection in Southern Arizona showed a light infestation of *Anthonomus grandis thurberiae*, Pierce, on cotton that was grown where none had been planted for some years. Light infestation of pink bollworm has spread in northern Florida and in western Texas. *Pimpla (Exeristes) roborator* and *Microbracon brevicornis*, which were released against it are not adapted to conditions in Texas and Mexico. The former emerges too early, and the latter does not survive the winter. *M. kirkpatricki* and *Elasmus* sp., received from Egypt, and *M. mellitor* and *Chelonus blackburni* from Hawaii were bred for release. In cage tests on insecticides for the cotton fleahopper (*Psallus seriatus*) the best results were obtained from a mixture of one part Paris green with ten parts sulphur.

622. COTTON BOLL WEEVIL SURVIVAL AND EMERGENCE IN HIBERNATION CAGES IN LOUISIANA. By R. C. Gaines. (*Tech. Bull. U.S. Dpt. Agr. No. 486*, 1936. From *Rev. App. Ent.*, xxiv., Ser. A, 5, 1936, p. 332.) Gives the results of an investigation carried out over a 15-year period from 1915-16 to 1930-31.

623. BOLLWEEVIL CONTROL WITH CALCIUM ARSENATE ON FIELD PLOTS IN MADISON PARISH, LA., FROM 1920 TO 1934. By M. T. Young. (*Tech. Bull. U.S. Dpt. Agr., No. 487*, 1935. Abstr. in *Rev. App. Ent.*, xxiv., Ser. A, 4, 1936, p. 255.) An account of field tests to determine the effectiveness of calcium arsenate dusts for the control of cotton boll weevil.

624. FIELD PLAT AND CAGE TESTS FOR BOLL WEEVIL CONTROL. By M. T. Young and G. L. Smith. (*J. Econ. Ent.*, xxix., 1, 1936, p. 105.)

625. DISTRIBUTION OF HIBERNATED BOLL WEEVILS IN AN OKLAHOMA COTTON FIELD. By E. Hixson. (*J. Econ. Ent.*, xxix., 1, 1936, p. 96.)

626. PERCENTAGE AND CAUSES OF MORTALITY OF BOLL WEEVIL STAGES WITHIN THE SQUARES. By G. L. Smith. (*J. Econ. Ent.*, xxix., 1, 1936, p. 99.)

627. OBSERVATIONS ON *Microbracon mellitor* (SAY) IN RELATION TO THE BOLL WEEVIL. By J. W. Folsom. (*J. Econ. Ent.*, xxix., 1, 1936, p. 111.)

628. A LAGARTA ROSADA E A NECESSIDADE DO TRATAMENTO PREVIO DAS SEMENTES DO ALGODAO. (The pink bollworm and the need for the disinfection of cotton seed.) By A. P. do Amaral. (*Campo*, vi., 12, 1935, p. 28. From *Rev. App. Ent.*, xxiv., Ser. A, 4, 1936, p. 260.) The pink bollworm has recently reappeared in numbers in the cotton fields of São Paulo, Brazil, after causing little injury for twenty years. Besides the removal and destruction of all crop remnants, cotton seed must be disinfected by immersion for thirty minutes in a 1 per mille solution of mercury bichloride just before sowing. Even after immersion in the solution for 7-10 days the seed has been found to have a high percentage of germination.

629. THE BIOLOGICAL POSSIBILITY OF INFESTATION BY FLIGHT OF THE PINK BOLLWORM MOTH. By L. W. Noble. (*J. Econ. Ent.*, xxix., 1, 1936, p. 78.) *Summary.* Fertilized pink bollworm moths were isolated from males and cotton, and exposed to temperatures comparable to those in which moths were taken in the upper air at Tlahuililo, Durango, Mexico, in September, 1928. After

seven days' isolation female moths were able to begin or resume oviposition of fertile eggs.

630. NOTES ON PINK BOLLWORM SEPTICEMIA. By G. F. White and L. W. Noble. (*J. Econ. Ent.*, xxix., 1, 1936, p. 122.) In the summer of 1932 a disease was observed among pink bollworms used in rearing parasites at the laboratory of the Division of Insect Investigations, Presidio, Texas. The disease was observed only under laboratory conditions, and not in the field. A study was made of the malady. Only full-grown pink bollworm larvæ that had completed feeding were used in the parasite laboratory, so that no observations on the disease were made on other instars. The infected mature larvæ became sluggish in the early stages of the disease, and soon after their death their bodies became brown, the shade deepening within a few hours to a dark brown or almost black. Microscopic examination of smears made from sick and recently dead worms showed the presence of numerous bacteria. No fungi, protozoa or polyhedral bodies were found. Cultures from these worms revealed the presence of only a few bacterial species, prominent among which were two species of *Bacillus* and one of *Streptococcus*. The three bacterial species were obtained in pure cultures, and healthy pink bollworms were inoculated with them, and also with material direct from diseased worms. Of twenty worms inoculated direct from diseased worms three died and became discoloured within 24 hours, seven additional worms died after 36 hours, and the remainder of the group appeared to be sick, and within 48 hours all were dead. The inoculation of worms with one of the species of *Bacillus* isolated and with the *Streptococcus* respectively, indicated that neither of these was pathogenic. Of fifty worms inoculated with a pure culture of the other *Bacillus*, the mortality was 100 per cent. within 24 hours. The symptoms of, and the bacteriological findings in the disease show that it belongs to the septicemia group of insect diseases, and the name "pink bollworm septicemia" has been given to it. The bacterium that is present in the septicemia and that is the immediate cause of death of the worms has been named *Bacillus pectinophoræ*.

631. ON SOME SPECIES OF BRACONIDÆ FROM NORTH CHINA AND KOREA. By C. Watanabe. (*Insecta matsum.*, x., No. 1-2, 1935. From *Rev. App. Ent.*, xxiv., Ser. A, 4, 1936, p. 244.) The Braconids recorded include *Microbracon* (*Bracon*) *nigrorufum*, Cshm., reared from *Platyedra gossypiella* (Pink bollworm) in Korea and North China, and *M. (B) isomera*, Cshm., *M. (Habrobracon) pectinophoræ*, sp. n., and *Chelonus pectinophoræ*, Cshm., from *P. gossypiella*, in Korea.

632. *Anomis erosa* HUBN. AS AN INSECT PEST OF COTTON. By J. T. Creighton. (*J. Econ. Ent.*, xxix., 2, 1936, p. 279.) It has been stated that the larvæ of the Abutilon moth are not very numerous on the cotton plant, but during a collecting trip in the fall of 1931 the writer collected several hundred lepidoptera pupæ from a cotton field near Gainesville, Florida, and 50 per cent. of the adults emerging from the pupæ were *Alabama argillacea*, and 50 per cent. were *Anomis erosa*. The life-history and habits of the latter, nature of injury to cotton, host plants, distribution, parasites, and predators, are discussed.

633. A LIST OF THE APHIDIDÆ OF CHINA WITH DESCRIPTIONS OF FOUR NEW SPECIES. By S. Tseng and C. Tao. (In Chinese.) (*Ent. and Phytopath.*, iv., 7-9, 1936. From *Rev. App. Ent.*, xxiv., Ser. A, 6, 1936, p. 370.) This systematic list comprises 108 species of Aphids, of which 24 are recorded for the first time in China, and 4 are described as new. It shows the plants they attack, and their distribution in China, and in other parts of the world.

634. OBSERVATIONS ON COTTON APHIDS (*Aphis gossypii*, GLOVER) IN THE VICINITY OF TSINAN (CHINA). By S. Tseng and C. Tao. (*Peking Nat. Hist. Bull.*, x., 3, 1936, p. 233. From *Rev. App. Ent.*, xxiv., Ser. A, 5, 1936, p. 324.) Descriptions

are given of the adults of all forms of this aphid and of the eggs and the nymphs of the wingless and winged parthenogenetic females. The winged viviparous aphids can produce a total of 2-26 young, or 1-10 in one day, and the wingless ones a total of 6-45, or 1-8 in one day. The reproductive period averages 2-75 and 10-6 days for the winged and wingless forms respectively. Reinhard's observations on the production of winged forms were confirmed, in that they appeared when the aphids were crowded or when the food plant did not provide suitable nourishment. After July winged individuals appeared and migrated to wild grasses or to the newly-developed leaves at the base of the main stem of the cotton plant. The wingless viviparous aphids mature in 4-7 days. During October and November the winged sexuparae or last generation of the alienicolae fly to primary food plants and produce wingless oviparae and winged males. After pairing the sexual females deposit eggs on the same or the next day. Oviposition continues for 1-8 days, during which 1-7 eggs are laid. In the field the aphids overwinter in the egg stage, but in a greenhouse at about 65° F. they continued to reproduce parthenogenetically, and passed the winter as winged or wingless parthenogenetic individuals on cucumber plants. Others attacking chrysanthemums produced sexual forms, and pairing and oviposition took place until the end of December, or one month later than on cotton in the field. A list is given of 43 species of plants on which *A. gossypii* has been found in the vicinity of Tsinan. The primary food plants include *Marubium supinum*, *Chrysanthemum sinense* and *Plantago major* var. *asiatica*.

Predators attacking *A. gossypii* were the Syrphids, *Paragus quadrifasciatus*, Mg., *Syrphus balteatus*, DeG., *Sphaerophoria menthastri*, L., and *Xanthogramma* (*Ischiodon*) *scutellare*, F., an unidentified Oscinid, the Coccinellids, *Coccinella septempunctata*, L., *C. (Ptychanatis) aziridis*, Pall., *Propylea japonica*, Thnh., *Hippodamia tredecimpunctata*, L., and *Hyperaspis reppensis*, Hbst., *Chrysopa japana*, Okamoto, *C. septempunctata cognata*, McLach., and an unidentified Reduviid. A Braconid of the genus *Aphidius* attacks the aphids as soon as they appear on the cotton leaves. During May and June the parasitism averages 10-95 per cent. Coccinellids and Chrysopids occasionally prey upon aphids already parasitized by *Aphidius* and the latter is itself parasitized by *Aphidencyrus* sp. The pupae of *S. menthastri* and *X. scutellare* are parasitized by *Pachyneuron* sp., and the Oscinid by *Euryischia* sp. The egg, larval and pupal stages of the Chrysopids occupy about 4, 8-10 and 14 days respectively. *C. septempunctata cognata* pupates on the leaves, and *C. japana* in the soil. The lengths of all the stages of *Coccinella septempunctata*, *C. aziridis* and *Propylea japonica* are tabulated. There are 3-4 generations a year. In cotton fields *A. gossypii* is often attended by the ants, *Lasius niger*, L., *Monomorium nipponense*, Wheeler, and *Formica fuscus japonica*, Motsch.

Two sprays proved very effective against the aphids, giving 98 per cent. control. The first consisted of 10 lb. tobacco, 1 lb. pyrethrum powder and 2 lb. soap in 100 gals. of water, and the second of a stock emulsion of 90 lb. cottonseed oil and 23-34 lb. soda (Na_2CO_3 and NaOH) in 4½-5 gals. of water, diluted for spraying at the rate of 1 : 15-20. To prepare the first spray, the tobacco and soap are each boiled separately in some of the water (the tobacco for 90 minutes) and the pyrethrum powder is boiled for 5 minutes in the soap solution.

635. OCCURRENCE OF *Aphis medicaginis* KOCH AND *Anomis flavia fimbriago* STEPH. ON COTTON IN SOUTH CAROLINA. By C. F. Rainwater. (*J. Econ. Ent.*, xxix., 1, 1936, p. 94.) A brief description of the insects and of the injury caused to cotton.

636. INVESTIGATIONS ON THE COTTON BOLLWORM, *Heliothis obsoleta*, FABR. By E. Parry Jones. (*Ann. Rpt.*, 1934, *Mazoe Citrus Exp. Sta.* Pubn. No. 4, 1936.

Br. South Afr. Co.) A detailed study of the Cotton Bollworm, *Heliothis obsoleta*, which is equally a pest of citrus fruits and other crops. The first part of the paper deals with the bionomics of the pest. The economic importance and damage to citrus is described, and a detailed account is given of the insect's life-history and habits whilst on this host plant. A study was also made of the life-cycle throughout the year, and of the influence of climatic factors on bollworm infestation. The second part of the paper is a progress report on the various aspects of control studied. Descriptions and figures of the various stages of the insect are included.

637. THE CORN EARWORM (*Heliothis obsoleta*) IN SOUTH-EASTERN GEORGIA. By G. W. Barber. (*Bull. 192, Georgia Exp. Sta., 1936.*) Deals with the importance of the insect, food plants, injury caused to corn, associated insects, damage by other insects following earworm attack, life-cycle of the pest, seasonal history, control measures.

638. *Orius insidiosus*, SAY, AN IMPORTANT NATURAL ENEMY OF THE CORN EARWORM. By G. W. Barber. (*Tech. Bull. U.S. Dpt. Agr. No. 504, 1936.* From *Rev. App. Ent.* xxiv., Ser. A, 6, 1936, p. 368.) An account is given of the work on *Orius insidiosus*, Say, an important predator of the eggs and newly hatched larvæ of *Heliothis armigera*, Hb. (*obsoleta*, F.), carried out at Richmond, Virginia, during 1928-29. This Anthocorid occurs throughout most of the United States and in southern Canada, and attacks many pests, particularly those that infest maize. Thus it has been observed by the author to destroy *Pyrausta nubilalis*, Hb., in Massachusetts, *Laphygma frugiperda*, S. and A., in Georgia, and *Diatraea crambidoides*, Grote, in Virginia. It passes the winter as an adult in protected places, and is found on flowers in small numbers from March to May or June, congregating on maize in July when the plants are about one foot high. The eggs, which are laid singly, generally on the moist fresh maize silks, hatch in 3-4 days. The nymphal stage occupies about 15 days. The nymphs feed at first on the moist silks, but in later instars prefer insect food. The length of life of the adults varies with the food; when fed on *Heliothis* eggs and newly hatched larvæ they lived long and deposited eggs over long periods, a few at a time. Females laid an average of 114 eggs. Adults receiving no animal food had short lives and laid no eggs. Nymphs occurred principally when the maize plants were in silk, and adults on plants that had young tassels or were in silk. Four generations a year seem to be possible in Virginia, but two or three are probably more common. The life-cycle may occupy 24 days. In central Virginia *Orius* destroyed an average of 38-47 per cent. of *Heliothis* eggs on maize plants over a period of several years. The percentage destroyed varied in different years and at different times during the season. It was highest among eggs deposited on silks and when other food, including aphids and thrips, was not available.

639. INVESTIGATIONS ON *Trichogramma lutea*, GIR., AS A PARASITE OF THE COTTON BOLLWORM, *Heliothis obsoleta*, FABR. By F. S. Parsons and G. C. Ullyett. (Reprinted from *Bull. Ent. Res.*, xxvii., 2, July, 1936.) *Summary.* Some of the problems involved in the estimation of parasitism in populations of *Heliothis* eggs are discussed: (a) Effective parasitism of the "active fraction" of eggs as laid *in situ* is defined. (b) The habits of the egg-laying moth in point of the duration of oviposition on individual crops and diversion of moth activity from one host to another, are discussed in relation to releases of *Trichogramma lutea*. Data are given on the distribution of bollworm eggs in a crop and associated factors. (c) Investigations on the dispersion of liberated parasites are described. Dispersion was found to be rapid and widespread; concerted activity by large numbers in given areas did not apply.

Investigations in rain-grown crops are described and results are quoted from a typical experiment in maize, wherein the percentages of parasitism recorded in a large number of equal sections of the crop are regressed on proportionate larval survival. Although the egg parasitism ranged from 21.2 per cent. to 82.3 per cent. differences in larval populations were inappreciable. An explanation for this is offered in an analysis of the effect of various mortality factors.

The parasite was relatively ineffective in cotton crops. The low degrees of parasitism found are assigned to the growth-habit of the plant, the scattered manner of egg deposition thereon, and the impediment offered to the insect by the dense hair processes of the plant at many sites where eggs are commonly placed.

Investigations on irrigated (cool season) market-garden crops and citrus orchards are described. These form the principal breeding sources of summer bollworm. Oviposition is extensive and sustained for three to four months on these crops, thereby affording opportunity for continuous parasite activity and the cumulative participation of progeny bred in the field. In nature *Trichogramma lutea* does not, however, appear until the latter end of the egg-laying by *Heliothis*, and the authors were unable to establish laboratory-bred representatives at an earlier period.

Another egg parasite, *Phanurus ullyetti*, is prevalent before *Trichogramma* appears, and accomplishes much that was hoped for from the attempted earlier introduction of *Trichogramma*. In effect, the latter, as seen from diagrams furnished with the paper, becomes substituted for *Phanurus* toward the close of the winter season. It is probable that temperature is a determining factor in the biology of both parasites, although other causes for the observed relations are suggested.

Further investigations are needed on the subject of exploiting *T. lutea* in the cool season.

640. TWO YEARS' FIELD EXPERIMENTS IN TEXAS ON THE CONTROL OF THE COTTON FLEA HOPPER WITH SEVERAL INSECTICIDES. By K. P. Ewing and R. L. McGarr. (*J. Econ. Ent.*, xxix., 1, 1936, p. 80.) Sixty-two field plat tests were made during 1933 and 1934 to determine the comparative efficacy of sulphur, sodium fluosilicate, a commercial mixture of 75 per cent. calcium arsenate and 27 per cent. Paris green, and calcium arsenate alone in controlling the cotton flea hopper. The infestation records and a count of the squares, blooms and bolls on cotton plants in the treated and untreated plats during the progress of the experiments, as well as the final yield of cotton from the various plats, showed that sulphur and the mixture of calcium arsenate and Paris green were effective in controlling the cotton flea hopper. Only two preliminary tests were made with calcium arsenate; these were in 1934, and gave fair results. The field tests indicated that sodium fluosilicate was not effective in controlling this insect.

641. REPORT ON COTTON LEAF-WORM INVESTIGATIONS IN FLORIDA, INCLUDING TEMPERATURE AND HIBERNATION STUDIES. By J. T. Creighton. (*J. Econ. Ent.*, xxix., 1, 1936, p. 88.) The nature of injury and economic importance, host plants, life-history and habits, hibernation, seasonal cycle, parasites and predators, are discussed. The following parasites are recorded on cotton leaf-worm: *Brachymeria ovata*, Say, *Syntomosphyrum esurus*, Rilev, *Sarphaga lambens*, Wd., *Beskia elops*, Walker, *Megaselia scalaris*, Liv., and *Pulexophora* sp. Many predators have been reported as attacking leaf-worm, including: *Podisus maculiventris*, Say, *Zelus bilobus*, Fabr., *Dysdercus suturellus*, Herrich-Schäffer, *Nezara viridula*, Linn., and *Allograpta obliqua*, Say.

642. THE IDENTITY OF THE COTTON STEM WEEVIL AND PARASITES OF THE CATERPILLAR OF *Cosmophila* AND THE COMMON MEALY BUG. By F. Q. Otones.

(*Philipp. J. Agr.*, vi., 4, 1935. From *Rev. App. Ent.*, xxiv., Ser. A, 5, 1936, p. 327.) Some of the unidentified insects mentioned in a recent report on cotton pests in the Philippines have now been determined. The parasite of *Cosmophila* is *Euplectrus manila*, Ashm., and the parasites of *Ferrisia* (*ferrisia*) *virgata*, Ckll., are *Leptomastix longipennis*, Merc., *Holanusomyia pulchripennis*, Gir., and *Blepyrus insularis*, Ashm. The cotton stem weevil stated to be similar to *Phylaitis* sp. is *Pempheres affinis*, Fst., which also attacks cotton in southern India.

643. A NOTE ON THE LOCUST POSITION IN NORTH-WEST INDIA AND BALUCHISTAN DURING 1935. By Y. Ramchandra Rao. (*Curr. Sci.*, iv., 5, 1935, p. 325. Abstr. in *Rev. App. Ent.*, xxiv., Ser. A, 4, 1936, p. 236.)

644. THE ORIENTAL MIGRATORY LOCUST (*Locusta migratoria manilensis*, MEYEN). By B. P. UVAROV. (*Bull. Ent. Res.*, 27, 1, 1936, p. 91. From *Rev. App. Ent.*, xxiv., Ser. A, 4, 1936, p. 233.) The available information on the outbreaks of this locust in China, North Borneo, the Philippine Islands, the Netherlands Indies, Formosa, and Malaya is reviewed.

645. A COMPARISON OF THE RATE OF METABOLIC ACTIVITY IN THE SOLITARY AND MIGRATORY PHASES OF *Locusta migratoria*. By C. G. BUTLER and J. M. INNES. (*Proc. Roy. Soc. (B)* No. 814, 1936, p. 296. From *Rev. App. Ent.*, Ser. A, 4, 1936, p. 229.) The possible physiological differences between phases *solitaria* and *gregaria* of *Locusta migratoria migratorioides* were investigated by means of accurate measurements of their oxygen consumption with a specially devised Barcroft apparatus. The technique employed is described, the oxygen uptake being measured per unit time and per unit area of body surface. In the individuals of the first instar there is no significant difference between the phases, but both males and females of phase *gregaria* in all the other instars show a higher rate of metabolism than the corresponding instar and sex of phase *solitaria*. The metabolic rate in the males, in all the instars and both phases, appears to be higher than that of the females. There is a marked falling off in the rate of oxygen uptake per unit area of body surface from the first instar to the third, after which the rate increases.

646. OBSERVATIONS ON RATE OF GROWTH, COLORATION AND THE ABNORMAL SIX-INSTAR LIFE-CYCLE IN *Locusta migratoria migratorioides*. By K. H. L. KEY. (*Bull. Ent. Res.*, 27, 1, 1936, p. 77. From *Rev. App. Ent.*, xxiv., Ser. A, 4, 1936, p. 232.) Observations were made on isolated individuals of *Locusta migratoria migratorioides*, R. and F. (ph. *solitaria*), kept under moist or dry conditions at a constant temperature (27° C. [80.6° F.]) and light intensity. The relative humidity in one case varied from 99 per cent. to saturation, and in the other between 5-10 per cent. rising to 50 per cent. for a few hours every day. The average weights of the instars were calculated from weighings made at all periods within them. In hoppers kept at saturation the figures did not show accurate doubling of weight from stage to stage, the progressive factor being in excess of two. The percentage rate of growth between the mid-points of successive stages was of the same order for all pairs. Already in the third instar the females were on the average 50 per cent. heavier than the male. The larval period lasted 38 days, the first three instars being of the same length, the fourth and fifth progressively longer. Hoppers kept in dry conditions were much lighter than those kept in wet, but the durations of the instars were longer, the total larval period lasting 56.8 days. The percentage rate of growth was just half that of hoppers kept at high humidity. About 85 per cent. of hoppers kept in humid conditions became green by the fourth instar, but the coloration of hoppers kept in dry air showed resemblance to black and white backgrounds. An extra

larval instar (either an extra third or fourth) that appeared in all the females from two particular egg-pods is considered to be due to an inherited factor.

647. THE RELATION OF HUMIDITY AND TEMPERATURE TO THE DEVELOPMENT OF THREE SPECIES OF AFRICAN LOCUSTS (*Locusta migratoria migratorioides*, *Schistocerca gregaria*, *Nomadacris septemfasciata*.) By A. G. Hamilton. (*Trans. Roy. Ent. Soc. Lond.*, 85, 1, 1936. From *Rev. App. Ent.*, Ser. A, 4, 1936, p. 227.) A description of experiments, all of which were carried out on the *transiens* phase of the above three species, and were designed to determine the factors influencing their life-cycle in different climates, with special reference to the effect of humidity and temperature on sexual maturation and diapauses.

648. THE OUTBREAK CENTRES OF *Schistocerca gregaria*, FORSK., ON THE RED SEA COAST OF THE SUDAN. By R. C. Maxwell-Darling. (*Bull. Ent. Res.*, 27, 1, 1936, p. 37. From *Rev. App. Ent.*, xxiv., Ser. A, 4, 1936, p. 231.) In addition to the Sudanese area, outbreak areas are likely to exist along the coast of Eritrea, south of the Sudanese border, and on the Arabian coast of the Red Sea. In fact, all parts of the sea-coasts of Africa and Asia with a winter rainfall reaching 240 mm. and extending for a period sufficiently long to allow of the development of two successive generations, must be regarded as probable outbreak areas.

649. A SHORT RECONNAISSANCE OF NORTHERN DARFUR (ANGLO-EGYPTIAN SUDAN) WITH REGARD TO *Schistocerca gregaria*, FORSK. By R. C. Maxwell-Darling. (*Bull. Ent. Res.*, 27, 1, 1936, p. 71. From *Rev. App. Ent.*, xxiv., Ser. A, 4, 1936, p. 232.) A short tour was made in Northern Darfur in 1934 to investigate the ecology of this locust. The country traversed is described, and illustrated by a map.

650. THE FOOD-CYCLE OF *Dysdercus fasciatus* (COTTON STAINER) IN ACACIA SAVANNAH IN NORTHERN RHODESIA. By A. G. Bebbington and W. Allan. (Reprinted from *Bull. of Ent. Res.*, xxvii., 2, July, 1936.) A study of the variations of the population of *Dysdercus fasciatus* on cotton and on its wild host plants is described. The most important host of *D. fasciatus* in the acacia savannah of Northern Rhodesia is *Thespesia rogersii*, and it is shown that at certain times a general flighting of stainer takes place from this host-plant caused by food shortage or defoliation. Generally, a period of food shortage occurs during the earlier months of the year, owing to rotting of the old crop and extensive destruction of the early new crop by the larvæ of a Cossid moth. This causes an early influx into cotton, which leads to the establishment of a large population in the field at a critical period in the development of the bolls. When the early crop is retained on the trees a continuously increasing food supply is provided, and this first movement does not take place. A second movement from *Thespesia*, which is largely due to defoliation, begins generally in June. It has been shown that a second influx into cotton coincides with this later movement from *Thespesia*. A late influx such as this is of little practical importance since the greater part of the crop is picked in May and June. The observations recorded indicate clearly that the movement of *D. fasciatus* into cotton is not due to any attraction exercised by the crop but is caused by a forced movement of stainers from *Thespesia rogersii*.

651. OUR ENEMY THE TERMITE. By T. E. Snyder (Comstock Pubg. Co. Inc., Ithaca, N.Y., 1935. Price \$3.00. From *Rev. App. Ent.*, xxiv., Ser. A, 5, 1936, p. 295.) About half of this book comprises an account of the various aspects of termite biology, with special reference to the species that occur in the United States, including such subjects as the origin, distribution and development of termites, metamorphosis and castes, colony foundation, food, inquilines and natural enemies. The remainder is devoted to the damage caused to plants, stored

material, and particularly timber and buildings, and to measures for preventing or controlling it, with details of the termite-proof construction of buildings. Appendices contain specifications for remedying termite damage to buildings, provisions for city building codes, and a list of the termites of the United States.

652. A NEW THRIPS ON COTTON. By D. Moulton. (*Philipp. J. Agr.*, vi., **4**, 1935, p. 475. From *Rev. App. Ent.*, xxiv., Ser. A, **5**, 1936, p. 327.) Descriptions are given of both sexes of *Bussiothrips claratibia*, gen. et sp. n. (sub-family *Heliothripinae*), taken on cotton in Manila during 1934.

653. CONTRIBUTION À L'ÉTUDE DE LA MALADIE DES CHANCRES DES TIGES DU COTONNIER CAUSÉE PAR *Helopeltis bergrothi*, REUT. By J. M. Vrijdagh. (*Bull. Agr. du Congo Belge*, xxvii., **1**, 1936, p. 3.) A stem canker, at first considered to be due to *Bacterium malvacearum*, ravaged the cotton in the Congo on several occasions. Further study showed that it was due to *Helopeltis bergrothi* Reut., which has many other hosts. The investigations are described.

The insect disappears in the dry season, reappearing with the rains, and occurs only in forest regions. The onset of the disease is sudden, and the lesions appear infectious. The disease is not infectious, however, but is due to the punctures of *Helopeltis*. The necrosed tissues are distributed around the puncture. A series of excellent microphotographs is given to illustrate the necrosis produced. The names of several natural enemies of *Helopeltis* are included, and it is suggested that these may be capable of multiplication. A list of literature ends the paper.

654. DO COMPOSTS CARRY DISEASE? (*Rhod. Agr. J.*, xxxiii., **6**, June, 1936, p. 375.) In view of the fact that greater use is now being made of composts, a letter was addressed to the Director of the Imperial Mycological Institute asking if he could supply any information as to whether the use of composts made from maize crop remains would be likely to increase the danger of diplodia infection in future crops. The following is an extract from Dr. Ashby's reply: "I believe there would be very slight and probably no risk of spreading the maize diseases caused by *Diplodia zeæ* and *Gibberella saubinetii* by adopting the Indore method of composting the stalks, trash and mouldy cobs, provided the material is suitably prepared and the method properly carried out. The optimum temperature for the germination of the spores and the mycelial growth of *Diplodia zeæ* lies between 80° and 86° F., and the maximum between 95° and 104° F.; a temperature 10° higher than the maximum if maintained for a relatively short period under the conditions of aeration and humidity of the fermenting mass would destroy that fungus and other pathogenic fungi. In a normal fermentation the temperature during the first few weeks may rise to about 150° F., and be maintained near that for a considerable time; such a temperature under the moist conditions of the fermentation must be rapidly destructive to the pathogenic fungi."

655. A PRELIMINARY REPORT ON THE STUDIES OF CERTAIN DISEASES OF COTTON. I. STUDIES OF THE CYRTOSIS. By S. C. Teng. (*Sci. Soc. China, Biol. Lab. Contrib. Bot.*, Ser. 6, **9-10**, 1931, p. 117. From *Exp. Sta. Rec.*, **74**, **5**, 1936, p. 667.) Studies of a disease of cotton in China, first described by Cook in 1920, and named cyrtosis or club leaf, and shown by S. C. Wang and H. Yuan in 1924 to be associated with the leafhopper *Chlorita biguttula*, Mats., are reported upon. The application of Bordeaux mixture as a repellent was found to protect plants from the disease, and used weekly starting from the time the leafhoppers began to appear, and ending at the time when the cotton plants ceased to form additional flowers, it gave an increase in yield of from 20-30 per cent. It is pointed out that late planting should be avoided, and that other food plants of the leafhopper in the vicinity of cotton fields should be destroyed.

656. CHEMICAL TREATMENTS FOR THE CONTROL OF THE CYRTOSIS OF COTTON. By S. H. Ou. (*Sinensia*, v., 5-6, 1934, p. 480. From *Exp. Sta. Rec.*, 74, 5, 1936, p. 667.) In the experiments conducted in continuation of those by Teng above noted, five applications of Bordeaux mixture (5-5-50) during the season actually increased the yield of cotton, due to less severe development of cyrtosis, from 11.3 to 35 per cent. With copper-lime dust the increase in yield was from 9.5 to 15 per cent.

657. INSECTS AS POSSIBLE DISTRIBUTORS OF *Phymatotrichum* ROOT ROT. By J. A. Taubenhause and L. D. Christenson. (*Mycologia*, xxvii., 1, 1936, p. 7. From *Rev. App. Mycol.*, xv., 7, 1936, p. 438.) When three species of soil-inhabiting insects were caged and fed on cotton roots covered with a copious growth of *Phymatotrichum omnivorum*, the fungus could not be reisolated from the faecal pellets or the insects themselves. Negative results were also obtained by feeding the insects on cotton leaves heavily coated with the spores of the fungus and on a sweetened solution containing a heavy suspension of the spores. It therefore appears to be probable that insects are not associated with the spread of *P. omnivorum*.

658. LONGEVITY OF SCLEROTIA OF *Phymatotrichum omnivorum* IN MOIST SOIL IN THE LABORATORY. By J. J. Taubenhause and W. N. Ezckiel. (*Amer. J. Bot.*, xxii., 1, 1936, p. 10. From *Rev. App. Mycol.*, xv., 7, 1936, p. 438.) The authors state that the results of experiments in which sclerotia of *Phymatotrichum omnivorum*, collected in 1929 from carrots in Texas, were kept for varying periods of time up to five years in the laboratory in stoppered vials with water, dry soil, or clay soil containing varying percentages of moistures, showed that the sclerotia in air-dry soil lost their viability before the first germination test, which was made nine days after the beginning of the experiment. Those in water and in soil with 10, 50 or 60 per cent. moisture were still viable at that date, but none germinated in the second test, one year later. In soils, however, with 20, 30, or 40 per cent. moisture, the sclerotia were still able to germinate at the end of five years, and to cause typical root rot of cotton seedlings.

659. HOST INDEX OF VIRUS DISEASES OF PLANTS. By M. T. Cook. (*J. Agr. Univ. Porto Rico*, 19, 3, 1935, p. 315. From *Exp. Sta. Rec.*, 74, 4, 1936, p. 498.) This index is not intended as a classification of either the diseases or the viruses causing them, but is an attempt to bring together the first records of each disease for the convenience of the workers in the virus group. The hosts are entered by scientific names under their respective families, both with alphabetical arrangement. "Up to the present time more than 5,000 papers and a few books have been published, and virus diseases have been recorded in about 80 families, more than 400 genera, and nearly 1,000 species of plants."

660. INDEX OF THE VECTORS OF VIRUS DISEASES OF PLANTS. By M. T. Cook. (*J. Agr. Univ. Porto Rico*, 19, 3, 1935, p. 407. From *Exp. Sta. Rec.*, 74, 4, 1936, p. 499.) In this annotated list, alphabetically arranged by the binomials of the vectors, the names are, in general, those used by the authors reporting the disease transmission.

661. THE PREPARATION OF GRADOCOL MEMBRANES AND THEIR APPLICATION IN THE STUDY OF PLANT VIRUSES. By K. M. Smith and J. P. Doncaster. (*Parasitology*, xxvii., 4, 1935, p. 523. From *Rev. App. Mycol.*, xv., 5, 1936, p. 306.) A detailed account of the technique established after three years' study by the authors for the preparation of Elford's gradocol membranes, and of their application to the study of plant viruses.

GENERAL BOTANY, BREEDING, ETC.

662. COTTON NOTES. (*Trop. Agriculture*, xiii., 6, 1936, p. 160.) By S. C. Harland. "In a recent paper, Davie ('Chromosome Studies in the *Malvaceae* and Certain Related Families.'—II. *Genetica*, 17, p. 487) discusses at some length the origin of the group of New World tetraploid cottons. He rejects the theory put forward by Skovsted (*J. Genet.*, 28, p. 407) on cytological grounds, and strengthened by the writer (*J. Genet.*, 30, p. 465) on genetical evidence, that the New World cottons are amphidiploids derived from two primitive diploid (thirteen chromosome) types, one of which was probably allied to the present-day diploid Asiatics, and the other to one or other of the diploid New World species. He finds it improbable that an Asiatic genom should be present in the New World cottons, and considers it more likely that the New World cottons arose from a cross between a wild American diploid and *G. mexicanum* or *brasiliense*. He points out that the Asiatic species *G. arboreum* and *G. herbaceum* were not introduced into America until after the time of Columbus. It is fairly clear that only unfamiliarity with the genetics and cytology of *G. mexicanum* and *G. brasiliense* and with the taxonomic affinities of these species can have led him to make this suggestion. The writer has examined specimens of *mexicanum* from Central America and it appears to be a species closely allied to *hirsutum*. The genetics of *brasiliense* have been studied in great detail for the past ten years, and it is undoubtedly so closely related to *barbadense* as to be worthy only of sub-specific rank. It is hard to see how crosses between undoubted typical New World tetraploids and wild diploids could have played any part in the origin of the New World types. The suggestion of Davie, though interesting, is incompatible with existing knowledge.

"The sporadic introductions of Asiatic species which must have been made in the sixteenth and seventeenth centuries would appear to have no bearing on the question under discussion, for even the average semi-wild tree cottons (*brasiliense*, *barbadense* and *purpurascens*) of Central and South America have lint so superior to that of ordinary Asiatic cottons that the cultivation of the latter, even if begun, would soon have been abandoned.

"The statement is made that 'the most important Asiatic (? hybrid) form derived from that species (*G. arboreum*, var. *neglecta*) was early carried to America and the West Indies by the East India Company, and is known in the United States to-day under the name of "Okra" cotton.' This statement is quite incorrect. Okra cotton is merely a form of *G. hirsutum* (Upland cotton) with lacinated leaves. What is known of the genetics of Okra cotton has been summarized in a paper by the writer (*Bibliog. Genet.*, 9, p. 107), cited by Davie, but apparently overlooked by him.

"Regarding the mode of origin of the New World cottons, the recent suggestion of the writer (*J. Genet.*, 30, p. 465) that they arose in late Cretaceous or early Tertiary times in some part of a Polynesian land bridge connecting America with Asia would appear to merit serious consideration since all the genetical and cytological evidence available is in its favour."

663. CONTRIBUTION DE LA GÉNÉTIQUE À LA SOLUTION DE QUELQUES PROBLÈMES PHYSIOLOGIQUES. By J. B. S. Haldane. (*C. R. Soc. Bio., Paris*, 1935, 119. From *Pl. Bre. Absts.*, vi., 4, 1936, p. 358.) The results of experiments on the action of genes controlling physiological phenomena show that genetics is not to be limited to the study of heredity and variation, but has a valuable contribution to make towards the elucidation of physiological problems.

Examples are quoted for both plants and animals which show that though the final expression may be such an apparently simple one as, for example, a

colour or the lack of it, yet the gene or genes in question control part of a complicated physiological and chemical process which leads to the colour change. Experiments with material lacking certain of the genes will therefore help towards a more complete knowledge of the reaction involved. Finally, the author makes some admittedly speculative suggestions as to the value of a gene.

664. THE QUANTITATIVE DISTRIBUTION OF BORON IN *Vicia faba* AND *Gossypium herbaceum*. By R. C. McLean and W. L. Hughes. (*Ann. App. Biol.*, xxiii, 2, 1936, p. 231.) The summary states that the boron content was ascertained by growing the plants in known concentrations of B_2O_3 . The boron distribution is regular and definite, with the highest percentage, per unit of dry weight, in the leaves, the petioles and stem apex (equal) next, then stem and root. This distribution does not appear entirely due to passive transportation in the transpiration current, the amounts are so small that it cannot be regarded as a nutrient; it is more probably an activator or regulator of metabolic processes.

665. THE RELATIONSHIP OF THE PHOSPHATE CONCENTRATION OF SOLUTION CULTURES TO THE TYPE AND SIZE OF ROOT SYSTEMS AND THE TIME OF MATURITY OF CERTAIN PLANTS. By A. L. Sommer. (*J. Agr. Res.*, 52, 2, 1936, p. 133.) Solution-culture experiments were carried out in a study of the relationship of the PO_4 concentration of the medium to the type and size of the root system, and the time of maturity of certain plants. In another type of experiment, cotton, a plant with a root system presenting a comparatively small surface for absorption and requiring a relatively high PO_4 concentration, was grown in containers with buckwheat and tomatoes, plants having more extensive root systems and making better growth at low PO_4 concentrations. Phosphate concentrations in the solutions were maintained at various levels, and the amount of phosphorus in the part of the stem between the roots and cotyledons and in the leaves was determined. Plants with the larger root systems made better growth at low PO_4 concentrations, and more phosphorus was found in their stems than in the stems of plants with root systems of comparatively small surface.

666. THE NITROGEN, PHOSPHORUS, AND CALCIUM CONTENT OF THE COTTON PLANT AT PRE-BLOOMING TO EARLY BOLL STAGES OF GROWTH. By H. F. Murphy. (*J. Amer. Soc. Agron.*, 28, 1, 1936, p. 52. From *Exp. Sta. Rec.*, 74, 5, 1936, p. 629.) Chemical analysis made at the Oklahoma Experiment Station, of plant parts, including the stems, leaves, and bolls from pre-blooming to early boll stages of growth, as well as of bolls at various stages of development, revealed a considerable absorption of calcium by the plant at this period, most being concerned with the vegetative part of the plant remaining in the leaves and stems. Intake of nitrogen and phosphorus also is high at this time, and while a considerable amount of each is needed for the rather extensive vegetative growth occurring, boll development accounts for much of these elements in the mature plant.

667. COTTON FLOWER: STRUCTURE. By E. R. Saunders. (*Ann. Botany*, 50, 1936, p. 247. From *Summ. of Curr. Lit.*, xvi, 13, 1936, p. 377.) Difficulties of interpretation of the character and number of the carpels in the family *Malvaceæ* are discussed. It is shown that throughout the family the gynæcium is composed of two carpel whorls, the outer sterile, the inner fertile, and various apparent anomalies are elucidated. The details include a description of the flower mechanism of *G. barbadense*. *Gossypium* is remarkable in that the number of carpels is not constant and the relations of the two carpel whorls are also peculiar.

668. SEED: VIABILITY TEST BY STAINING. By K. Hasegawa. (*Japanese J. Bot.*, 8, 1936, p. 1. From *Summ. of Curr. Lit.*, xvi, 11, 1936, p. 315.) A method

for testing the viability of seed depends on the dark staining of living protoplasm with 1 per cent. solutions of telluric or selenic salts, especially sodium tellurate. The embryos of living seeds then turn uniformly dark indigo or black inside, bad seeds turn dark brown or become spotted; dead seeds do not colour at all. The tables of results given indicate the efficacy of the test, and a coloured plate illustrates the types of changes observed.

669. COTTON SEED PRODUCTION. By B. P. Straumal. (*Bull. All-Union Sci. Res. Cott. Inst. (NIHI)*, Tashkent, 1935, No. 2 (16): 3-8, 139. From *Pl. Bre. Absts.*, vi., 4, 1936, p. 405.) The famous variety Navrotskii, bred by E. L. Navrotskii in 1914 from the variety Russells, was produced by selecting for high ginning percentage and it is in consequence somewhat deficient in lint length, which defect has been accentuated by later generations of seed multiplication. The new variety 8582, resembling Navrotskii in most respects, exceeds it by 10-15 per cent. in yield of lint, and 1-1.5 mm. in lint length. S. S. Kanash, who produced this variety, states that it was obtained from Acala by selection, but it seems more probable that the original plant was a hybrid between Navrotskii and Acala or some similar variety. In 1934 it yielded 9.26 c. per hectare, as opposed to 9.71 from Navrotskii, and its further cultivation is strongly recommended. Other promising varieties are Triumph Navrotskii, 8427, 8517, and M2. The two last-named have effected a notable increase in the lint length of the cottons produced, as compared with Navrotskii and Triumph Navrotskii.

The success of the scheme of seed distribution of the new varieties is analyzed.

670. ORIGIN OF THE FRINGE TISSUE OF THE COTTON SEED. By R. G. Reeves. (*Bot. Gaz.*, 97, 1, 1935. From *Exp. Sta. Rec.*, 74, 5, 1936, p. 617.) In this study at the Texas Experiment Station, the fringe tissue (often termed "perisperm") of the cotton seed is shown to originate as the inner epidermis of the inner integument.

671. ÉTUDE TECHNOLOGIQUE D'UN COTON DU TONKIN. By F. Heim de Balsac and O. Roehrich. (*Coton et Cult. Coton*, x., 1, 1936, p. 13.) The cotton studied was derived from a lot originally obtained from Tashkent in Turkestan. It is of good colour and fineness, "middling" in classification, with a staple length of 33 mm. (equal to a superior American or Upper Egyptian cotton), and is fairly strong.

FIBRE, YARN, SPINNING, WEAVING, ETC.

672. TEXTILE FIBRES OF VEGETABLE ORIGIN: FORTY YEARS OF INVESTIGATION AT THE IMPERIAL INSTITUTE. By Dr. E. Goulding. (*J. Text. Inst.*, xxvii., 6, 1936, p. 124.) *Cotton.* Since the early years of this century much useful work in connection with cotton has been carried out by the Imperial Institute. This included: "the examination of the quality and defects of specimens of cotton from nearly all the Governments of the tropical Colonies and Protectorates as well as from spinners, and the preparation of reports and recommendations thereon; the conduct of special investigations connected with such collateral subjects as the best method of disinfecting cotton seed, the identification and control of insect and fungus pests which attack the cotton plant, and the analysis of soils."

This work was continued until 1914. After the war the assistance of the Institute was in less demand owing to the formation of the British Cotton Industry Research Association in 1919, and the establishment of the Empire Cotton Growing Corporation in 1921. In recent years, the Institute has been able to co-operate to some extent with the Corporation, especially in relation to experiments on rotation crops for cotton which have been carried out at the Corporation's Plant

Breeding Station at Barberton, Transvaal. In this connection the Institute has analyzed a large number of samples, representing different parts of plants produced in the course of an investigation, to ascertain the amounts of plant-food constituents removed from the soil by each crop of a rotation.

673. A PRACTICAL LABORATORY METHOD OF MAKING THIN CROSS SECTIONS OF FIBRES. By J. I. Hardy. (*U.S. Dpt. Agr., Circ.* 378, 1935. From *Exp. Sta. Rec.*, 74, 5, 1936, p. 732.) The use of a device invented by the author, and described, enables one in a few minutes to cut a cross section of a group of from 100 to 300 fibres thin enough for critical examination of their internal structure. This device provides a means for holding the fibres and pushing them through a slot 0.0065 in. wide. Celluloid solution is applied to the ends of the fibres and allowed to dry. The thin film of celluloid containing the cross section is cut off with a safety-razor blade, mounted in Canada balsam, and is ready for microscopic examination.

674. "FIBROGRAPH" COTTON FIBRE LENGTH ANALYZER. By K. L. Hertel and M. G. Zervigon. (*Text. Res.*, 6, 1936, p. 331. From *Summ. of Curr. Lit.*, xvi., 13, 1936, p. 373.) An optical method of direct analysis of distribution of fibre lengths in cotton is described which requires that the fibres shall be arranged with one end on a common base line, and that the cotton is uniform in optical properties. The light transmitted at any point in the prepared sample is then a measure of the number of fibres at that point, and therefore of the number in the particular length range. The instrument used is called a "Fibrograph" and is essentially a null optical instrument with an electric indicator, and suitable recording elements. The instrument and its operation are described in detail for the case of combed seed haloes, with the interpretation of the results. A comparison of "Fibrograms" and measured cumulative length frequency curves is given. Three difficulties are encountered: (a) the fibre profile distorts the fibrogram from a true length-distribution curve; (b) care must be exercised in combing the fibres and in arranging them into a uniform sample; (c) the test seed sample is too small to be adequate—at least six fibrograms had to be combined to give agreement with the true length-frequency curve. These points are discussed, and the authors state that they are attempting to interpret fibrograms prepared from random, unaligned samples.

675. COTTON MILL LABORATORY: WORK AND EQUIPMENT. By H. D. Evans. (*Cotton U.S.*, 100, 2, 1936, p. 73. From *Summ. of Curr. Lit.*, xvi., 8, 1936, p. 220.) The work and equipment of the mill laboratory of the Pepperell Manufacturing Co. are described, and improvements in processing suggested by a study of data obtained in routine testing are discussed. These include improvements in regularity of rovings; large scale launderability tests on sheets; and sizing experiments with a high-speed tape frame.

676. COTTON SPINNING MACHINERY. By J. Tetlow. (*Text. Wkly.*, xvii., 433, 1936, p. 704.) A brief survey of some modern improvements.

677. THE EFFECT OF EMPLOYING DIFFERENT ROLLER SETTINGS AND TWISTS ON THE SPINNING PERFORMANCE OF THREE INDIAN COTTONS. By R. P. Richardson and N. Ahmad. (*Tech. Bull., Ser. A, No.* 32, Ind. Cent. Cott. Comm., 1936.) *Summary.* The object of the tests described in this bulletin was to study the effect on the spinning performance of Indian cottons of using different twists in the fly frames and roller settings in the ring frame. For this purpose three Indian cottons, K 22, P.A.4F., and Surat 1027 A.L.F., were selected, the first being short and coarse, the second short but relatively fine, and the third possessing a staple of medium length. The settings and twists normally employed at the Laboratory were taken as standard, and these were varied on

either side within the practical range. The mean fibre-length and the fibre-weight per inch of each of the three cottons were determined. Each cotton was processed with the different settings and twists and spun into suitable lengths. The yarns obtained were examined for lea breaking strength, single thread strength, evenness, number of neps per yard, etc. The number of yarn breakages sustained by each doffing during the spinning process was recorded.

From the experimental data the following conclusions were drawn:

The two short staple cottons registered fewer yarn breakages in the ring frame with $\frac{1}{16}$ in. than with $\frac{1}{8}$ in. front roller setting. Among these the finer cotton responded better to the change in settings than the coarser one. The effect on the number of yarn breakages of changes in the settings of the other frames was either small or anomalous. It was clear that these effects were being masked by other factors, pointing to the desirability of further work. Compared with the normal setting of the Laboratory, a closer front roller setting ($\frac{1}{16}$ in. gauge) in the ring frame was decidedly beneficial to the strength of the resultant yarns with the two short stapled cottons, but was of doubtful value with the medium stapled cotton. By using closer front roller settings both in the ring and the roving frame with reduced twist in the latter machine, the increase in yarn strength was more pronounced, especially in the case of the two short staple cottons. As against this, closer settings and reduced twist in the three fly frames effected no change in the yarn strength of K. 22, a very small improvement in that of P.A.4F, and a reduction in that of Surat 1027 A.L.F. Thus, on the whole, closer front roller settings in the rover and the ring frame are definitely advantageous with a short and coarse cotton like K.22, somewhat less so with a short but fine cotton like P.A. 4F, and of doubtful advantage with medium staple cotton like Surat 1027 A.L.F. In order of merit, the effect is greatest when a change in the front roller setting is made both in the ring frame and the rover, less so when it is made in the ring frame only, and least of all when it is effected in the three fly frames. The effect of opening the front rollers on yarn strength is in the opposite direction to that of closer settings. With this change, the yarns, on the whole, are found to be weaker than with the normal settings of the Laboratory. As would be expected, the loss in strength is greatest when the wider settings are employed both in the rover and the ring frame, somewhat less so when the change is confined to the ring frame, and least of all when these alterations in settings are made in the fly frames.

678. COTTON YARNS: CONTINUOUS TESTS. By A. Grote. (*Spinn. u. Web.*, 54, 17, 1936, p. 3. From *Summ. of Curr. Lit.*, xvi., 11, 1936, p. 310.) An account is given of tests made on cotton yarns of different qualities spun from Peruvian, Egyptian and Brazilian cottons. A Frenzel-Hahn yarn testing apparatus was used. The ends of 2.5 m.-lengths were joined together and the loops run continuously in the testing apparatus, adjusted to give extensions of 1, 2 and 3 per cent. until break occurred. The number of passages before break was observed and also the tension in the yarn. The tension increased at first in each case, then continued practically constant for a period and finally showed a tendency to decrease just before break occurred. The observed variations are shown graphically. Tests were also made with 100 m.-lengths of the yarns with one passage through the testing device, and permanent and elastic extensions were determined. The results of intermittent tests are briefly discussed. Curves showing the variation in permanent extension with number of passages through the tester show a rapid increase in permanent extension in the first four passages followed by a fall, and finally a more gradual rise with increasing number of passages.

679. COTTON AND COTTON YARNS: MOISTURE CONTENTS. By R. Setzer. (*Textilber.*, 17, 1936, p. 192. From *Summ. of Curr. Lit.*, xvi., 10, 1936, p. 274.)

The relations between atmospheric temperature, relative humidity and absolute humidity are discussed, and the indicating system of the Lambrecht Thermohygrometer is briefly described. The variation of the moisture content of cotton with changes in atmospheric humidity is discussed, and curves are given showing the variation of moisture content with temperature of Egyptian and American cottons and yarns spun from them at different relative humidities.

LEGISLATION.

680. AUSTRALIA: *Statutory Rules*, 1935, No. 105, dated October 23, 1935, amend regulations 3 and 5 of the Statutory Rules, 1935, Nos. 12 and 31.

Statutory Rules, 1936, No. 22, dated February 26, 1936, give the regulations governing the grading of raw cotton, claims for bounty, distribution of bounty to growers, the keeping of accounts, inspection of accounts by auditors.

681. UNITED STATES: *Pink Bollworm Quarantine No. 52. Revision of Quarantine and Regulations.* (U.S. Dpt. Agr., B.E.P.Q., 52, Washington, D.C., 1936. From *Rev. App. Ent.*, xxiv., Ser. A, 5, 1936, p. 333.) This revision (effective December 5, 1935) of Quarantine No. 52 against pink bollworm releases from restriction all parts of the State of Georgia formerly included in the regulated area. As careful inspections made throughout the area in 1934 and 1935 gave negative results, it is believed that eradication efforts have been successful there.

TRADE, PRICES, NEW USES.

682. AFRICAN COTTON: STATISTICS. By G. Braun. (*Wirtschaftsdienst*, 21, 1936, p. 471. From *Summ. of Curr. Lit.*, xvi., 9, 1936, p. 230.) The author discusses the production of cotton in all parts of Africa, excepting Egypt, but including the Anglo-Egyptian Sudan. Statistics are given of (a) imports of African cotton by European countries, India and Japan, and (b) exports of cotton from eight British-African territories, five French, two Belgian, three Portuguese and two Italian.

683. WORLD COTTON PROSPECTS. (*Text. Wkly.*, xviii., 435, 1936, p. 7.) A survey of the cotton position by the Bureau of Agr. Economics of the U.S. Dept. of Agriculture, Washington, dated June 9. The following is extracted from the report: "Cotton prices show a rising tendency. Mill activity through the principal cotton consuming centres continues to run at a high level; world consumption of all kinds of cotton is at a record-breaking rate which may amount to nearly 27,000,000 bales for the season. . . . Consumption of American cotton in Europe continues well, although it is being discouraged by the persistent tendency for the price of American cotton to strengthen relative to foreign during recent months. The general European textile situation during recent months has been one of slow but fundamental recovery, based almost entirely upon improved demand from the domestic market in each country. . . . The industry continues active in Japan, but with both yarn production and exports of cotton cloth somewhat below the record high levels of a year ago. . . . Reports indicate that the new crop area in both Egypt and Russia will be somewhat larger than in 1935-36."

684. EASTERN INDUSTRIALIZATION AND ITS EFFECT ON THE WEST, WITH SPECIAL REFERENCE TO GREAT BRITAIN AND JAPAN. By C. E. Hubbard. (Oxford Univ. Press, London, 1936. Price, 18s. net. Reviewed in *Int. Cott. Bull.*, xiv., 55, 1936, p. 377.) A penetrating study of Japanese economic and industrial progress. The chapters dealing with Great Britain describe in an unbiased manner the post-war conditions of the exporting industries, paying special attention to the textile industry by examining the present position, its losses in

overseas markets and the causes, the finance and labour factors, in comparison with Japan.

685. COTTON FABRIC FOR REINFORCING BITUMINOUS SURFACES ON HIGHWAYS. (*Highways Res. Absts. No. 32*, Washington, D.C., July, 1936.) The results of experiments in the use of cotton fabric for roads are given from the three following States:

Georgia.—"In October, 1935, three years after construction, visual inspection can detect no difference between the part of the road where fabric was used and where it was not used."

New Jersey.—"An inspection of the road was made January 21, 1935, five months after construction. Due to snow and light rain for two days the road and adjoining ground were saturated. On the part of the road where the fabric had not been used the surface was broken in some twelve places. The broken areas were from .5 to 1.5 sq. ft. in area and were quite soft. In other places the surface was resilient and water would ooze to the surface under pressure with a blunt instrument. On the other hand, there were no broken places in the section which had been treated with the fabric. This surface was tougher and less easily punctured with a screw driver, although there were indications that water had oozed through to the surface in some spots."

Texas.—"Until 1933 the experimental sections constructed in 1929 were closely observed. Both sections, with and without fabric, remained in good condition and no difference could be detected by visual observations."

MISCELLANEOUS.

686. COTTON RESEARCH GRANTS. (*Text. Wkly.*, xvii., 427, 1936, p. 528.) A grant of £500 a year for five years has been made by the trustees of the Cotton Trade War Memorial Fund to the Economics Research Section of the Manchester Faculty of Commerce and Administration to continue the research into matters connected with the cotton industry. A grant of £400 a year for two years has been promised by the Royal Institute of International Affairs in support of research work in the Economics Research Section into cotton weaving wages and labour.

ADDENDA.

687. IL COMMERCIO DEL COTONE: COTONI AMERICANI. By Prof. U. Borroni, of the Coml. Univ. of Milan. (Pubd. by A. Giuffrè, Milan, 1936.) This is a detailed study which should prove of value to those concerned with the American cotton trade and who understand the Italian language. A great part of the work consists of quotations from, and discussions of the literature, arranged as footnotes. Beginning with a general account of world trade, the author gives on p. 21 some figures of Italian imports (in thousands of quintals):

			<i>U.S.</i>	<i>India.</i>	<i>Egypt.</i>	<i>Others.</i>
For 5 years, 1909-13	...	...	1,275	420	105	41
" " " 1930-34	...	...	1,329	304	236	57

The three principal cropping systems of the United States, the "share-cropping," "share-renting," and "cash-renting" are discussed, and considerable detail is given regarding the methods of using the land and disposing of the proceeds. The second chapter deals with local buying. Ginning and the costs of ginneries are discussed, and the methods of selling, including the operations of the banks, are described in detail. The third chapter is concerned with wholesale marketing and exportation, and treats of the merchant, the spot cotton merchant, the markets, etc. The book ends with a glossarial index, and contains a valuable list of literature.

688. BELGIAN CONGO. We have received from the Comité Cotonnier Congolais, Brussels, the first copies of their new journal, *Bulletin Trimestriel du Comité Cotonnier Congolais*, which deals mainly with cotton-growing in the Belgian Congo. The following, among other papers, are included in the first issue: "La culture cotonnière au Congo Belge," "La campagne cotonnière en 1935, et en 1936," "L'égrenage du coton aux États-Unis" (M. Pilette). The second number contains the following: "L'organisation de la culture cotonnière au Congo Belge" (A. Ravet), "Les fermes indigènes en Nigeria" (A. Ravet), "Le rôle des scies dans l'égrenage" (M. Pilette). Notes are also included on cotton in neighbouring colonies, marketing, legislation, etc. We wish the new journal every success.

689. BULLETIN OF MISCELLANEOUS INFORMATION. ADDITIONAL SERIES XII. CULTIVATED CROP PLANTS OF THE BRITISH EMPIRE AND THE ANGLO-EGYPTIAN SUDAN (TROPICAL AND SUB-TROPICAL). By H. C. Sampson. (Pubd. H.M. Stat. Office, London, 1936, price 6s. 6d. net.) This is a work of reference which will be of the greatest use to all concerned with economic plants in the Empire. The information furnished in this Inventory of Cultivated Crop Plants was asked for by the Conference of Colonial Directors of Agriculture held in 1931, and is based on the replies to a questionnaire issued by the Director of the Royal Botanic Gardens, Kew, and forwarded by the several Departments of State concerned to all tropical and sub-tropical countries of the British Empire, and to the Anglo-Egyptian Sudan. A copy of this questionnaire, together with the explanatory notes and covering letter, is included as an appendix to the publication. It is not claimed that the book is free from error, since in some cases officers may not have had the necessary facilities nor the requisite knowledge to enable them definitely to determine the species of the plant referred to. Every effort, however, has been made to ascertain the correct name of the species cited, and to avoid error so far as possible. The work is arranged by genera in alphabetical order, and great care has been taken in giving the synonyms of each name, a matter of considerable importance with economic plants where a change of name is not easily adopted. The common and the vernacular names are also given—another feature which is of much value, especially in the case of plants cultivated in India, with its great variety of tongues. Then follow the countries where the crop is now being grown, or has been tried.

The second part of the book contains a series of notes on some of the most important crops constituting the staple foods of the tropics and sub-tropics on which the indigenous peoples of the British Empire are dependent for their livelihood and existence. The history and plant characters—such as habit, hairiness, shape of fruit and seed, period of growth, etc.—of the different varieties in each species, are discussed, and a useful bibliography is also included for each species. The book contains information of great value, especially to officers of the several Departments of Agriculture, and should stimulate the trial of new crops, and of other varieties of the crops already under cultivation.

PERSONAL NOTES

APPOINTMENTS.

WEST INDIES.

Mr. C. W. R. McCreary has been appointed by the Corporation as an Assistant in the Genetics Department of the Cotton Research Station, Trinidad.

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are on the Fourth Floor of King's Buildings, Dean Stanley Street, Millbank, S.W. 1.

At the time of writing the following officers are on leave in this country from cotton-growing countries:

Cyprus ...	...	...	...	...	...	Mr. A. Pitcairn.
" ...	...	...	...	...	...	Mr. B. J. Weston.
Gambia ...	...	...	...	...	...	Mr. J. Pirie.
Gold Coast ...	...	...	...	...	...	Mr. J. E. Symond.
Kenya Colony ...	...	...	...	...	...	Mr. P. C. Chambers.
Nigeria ...	...	...	...	...	...	Dr. G. Bryce.
" ...	...	...	...	...	...	Mr. J. E. James.
" ...	...	...	...	...	...	Mr. J. R. Miller.
" ...	...	...	...	...	...	Mr. J. W. R. Pedder.
" ...	...	...	...	...	...	Mr. A. F. W. Sheffield.
" ...	...	...	...	...	...	Mr. W. A. Watson.
Northern Rhodesia ...	...	...	...	...	...	Mr. U. J. Moffat.
Tanganyika Territory...	...	...	...	...	...	Mr. J. R. Curry.
" "	...	...	...	...	...	Mr. S. M. Gilbert.
" "	...	...	...	...	...	Mr. H. Gillman.
" "	...	...	...	...	...	Mr. N. R. Ruggles Couchman.
" "	...	...	...	...	...	Mr. H. B. Stent.
" "	...	...	...	...	...	Mr. R. R. Le Ceyt Worsley.
Uganda ...	...	...	...	...	...	Mr. G. F. Clay.
" ...	...	...	...	...	...	Dr. G. Griffiths.
" ...	...	...	...	...	...	Mr. A. G. De Courcy-Ireland.
" ...	...	...	...	...	...	Mr. A. J. Kerr.
West Indies: <i>Trinidad</i> ...	...	...	...	...	...	Mr. E. J. Gregory.

The following officers of the Corporation's staff are on leave in this country:

Nigeria ...	...	...	...	...	...	Mr. A. E. Casement.
Nyasaland...	...	...	...	...	...	Mr. S. T. Hoyle.
Southern Rhodesia ...	...	...	...	...	...	Mr. J. E. Peat.
South Africa ...	...	...	...	...	...	Mr. F. R. Parnell.
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